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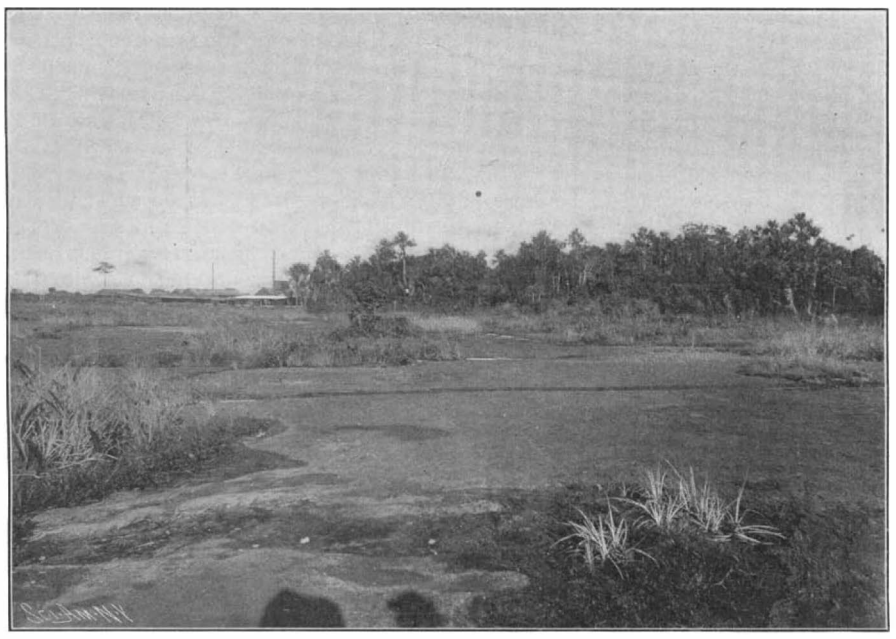
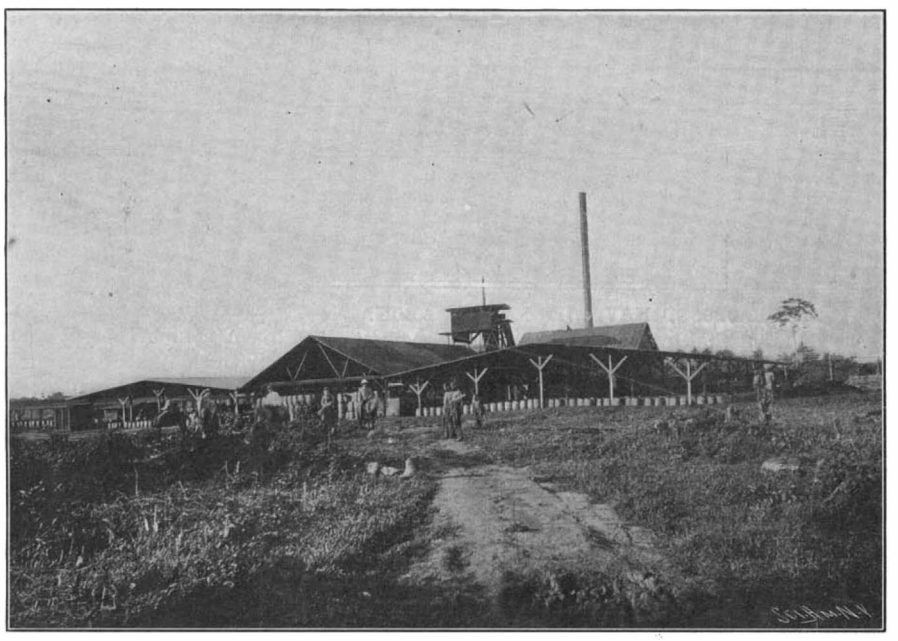
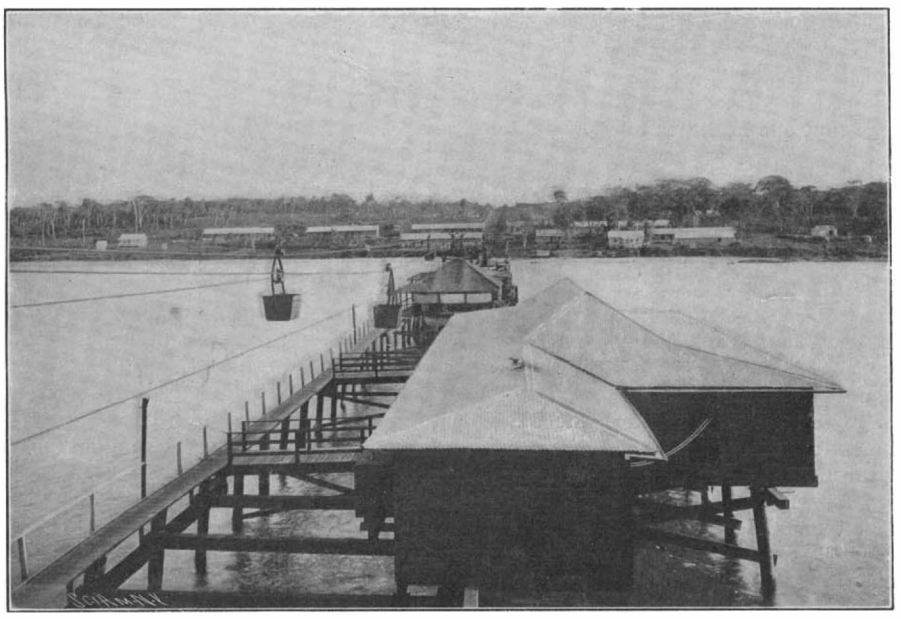


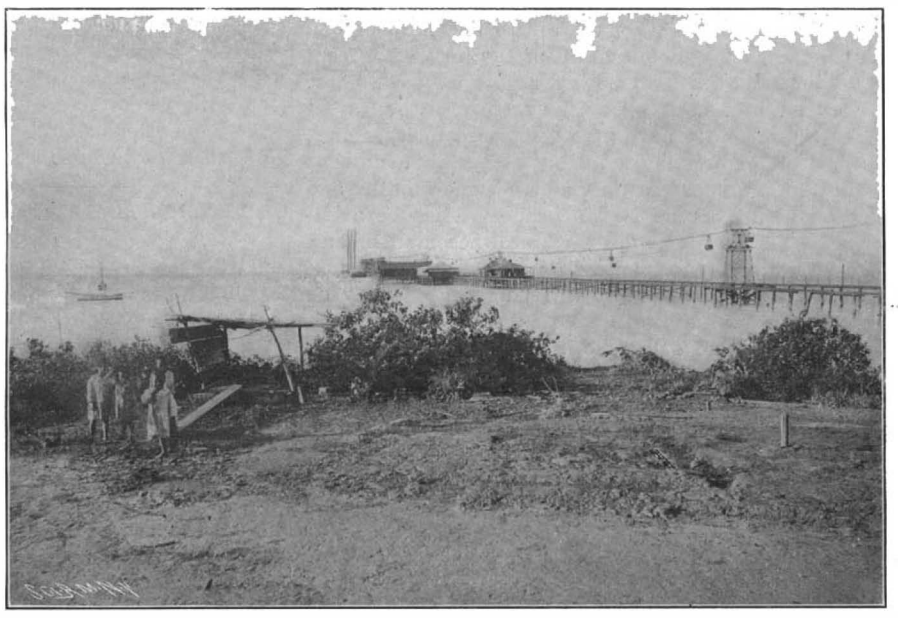
PITCH LAKE, LOOKING TOWARD TERMINAL STATION



TERMINAL STATION AND DRYING PLANT.



VIEW FROM OFFICE, LOOKING TOWARD PITCH LAKE.



JETTY WHERE ASPHALT IS LOADED.

THE PITCH LAKE, SHOWING THE ASPHALT AND THE POOLS OF WATER.

THE PITCH LAKE AND THE ASPHALT INDUSTRY OF TRINIDAD. [See page 166.]

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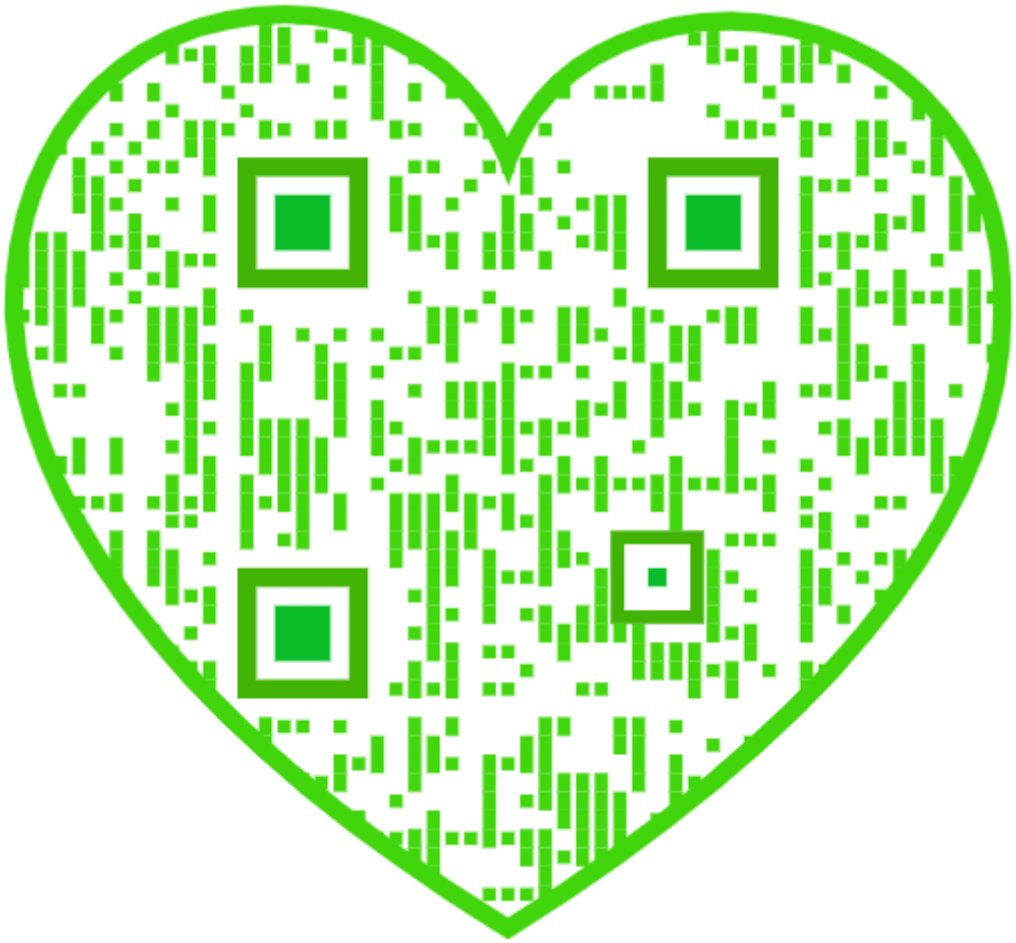

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NEW YORK, SATURDAY, MARCH 16, 1901.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE PROPOSED NAVAL MEMORIAL ARCH.

Although, at the time, it was a matter of regret to the friends of the United States Navy—that is to say, to every right-hearted American—that the memorial arch which was erected at the time of the home-coming of Admiral Dewey was not perpetuated in marble as a lasting tribute to the triumphs of our navy in the late war with Spain, for various reasons it was certain that the appeal for the necessary funds to build a permanent Dewey Arch would meet with a half-hearted response. The committee which had charge of the scheme has done the wise thing in returning the subscriptions and giving the matter a quiet burial.

The failure of the Dewey Arch proposal has left the way clear for the erection by the people of the United States of a memorial, not merely to one hero of one particular naval war, but to all of the men who, from Paul Jones and Perry to Dewey, Sampson, and Schley, have contributed to the glory and renown of the United States Navy; and we are greatly pleased to learn that the project for erecting a fitting memorial monument of the kind, which was undertaken some months ago by the alumni of the Naval Academy, has been advanced so far that it is now certain of accomplishment.

The memorial is to take the form of an arch of such colossal proportions that it will be twice as lofty as the Dewey Arch, and will exceed in height and bulk the famous Arc de Triomphe in Paris, and will, therefore, be the largest structure of the kind in ancient or modern times. It will be enriched with sculpture symbolical and commemorative of the greatest events in the history of the navy, and niches will be provided to receive statues of past and future admirals.

This noble memorial is to be raised on the sea wall of the Battery, New York, and it will be approached through a handsome sea gate and inclosed basin, the basin being flanked by two piers, at the end of each of which will be placed a colossal beacon. The arch will stand in a spacious plaza, which will be ornamented with appropriate statues and naval trophies. The whole structure will be built in white marble, and it is expected that the construction, which is to be commenced this spring, will take three years to complete.

The designs have been accepted by the committee, the Battery site has been approved by the Mayor, the Municipal Art Commission and the Park Commission; a large part of the necessary funds for construction have been promised, and assistance is to be sought from the city, the State and the National government.

This admirable project should command the active support of the citizens, not merely of New York, but of every State of the Union.

VAST AND INCREASING BULK OF THE MODERN STEAMSHIP.

Great as are the dimensions of the latest transatlantic freight and passenger steamers, there are ships now under construction which will exceed them on every point of comparison. The past decade has seen a similar increase in the dimensions of the motive power and rolling stock used in land transportation; but in that field it is safe to say that the limits imposed by the size of tunnels, the height of bridges, and the width of platforms, will prevent any considerable increase in the future, either of locomotive or cars. Transportation on the high seas, however, has no such limitations to contend with; for whereas to accommodate larger rolling stock on the railroads it would be necessary to rebuild numerous costly structures, from one end to the other of the system, on the high seas there is absolutely no restriction to size, and the only changes that are necessary to accommodate these mammoth steamships are those incidental to the deepening of harbor channels and the provisions of docks of sufficient length and capacity.

There are now under construction three freight and passenger steamships which will exceed in size anything now afloat, not even excepting the "Oceanic." Two of these, which are being built by the Eastern Shipbuilding Company, New London, Conn., for the Great Northern Steamship Company, are intended to ply between Seattle, the terminus of the Great Northern Trans-Continental Railroad, and Oriental ports. The third vessel, which is being built for the White Star Company, is nearing completion at the yards of Harland & Wolff, Belfast. The New London vessels will be, primarily, cargo boats, but they are also arranged to carry a very large number of passengers. Although these ships are only 630 feet long—or 74 feet less than the "Oceanic," which is the longest ship in the world—they have 4 feet 8 inches greater beam, the beam of the new boats being 73 feet, against 68 feet 4 inches, and their molded depth is greater. So large is their midship section that on their maximum draught it is estimated they will displace 33,000 tons. On a maximum draught of 35 feet, the displacement of the "Oceanic" is estimated at 32,500 tons. The new passenger steamship for the White Star line, which will be launched at Belfast, April 4, will be a larger ship than the "Oceanic," larger, indeed, than the two New London vessels. Her length is to be 700 feet, or 4 feet less than that of the "Oceanic," but her beam is to reach the unprecedented width of 75 feet, and her estimated maximum displacement will be about 36,000 tons.

A comparison of this beginning-of-the-century vessel with those at the commencement of the last two decades proves at what an astonishing rate the dimensions of the modern steamship are growing. In the commencement of the year 1881 the longest and the largest steamer in the world was the "City of Berlin," now the "Meade" of the United States army transport service. She is 520 feet long, and her displacement is 8,000 tons. Ten years later, in 1891, the "City of Paris," 560 feet long and about 16,000 tons displacement, was the largest vessel afloat, while in the year 1901 the largest vessel will have a length of 700 feet and a displacement of 36,000 tons. It will be noticed that the displacement, which is the true measure of a vessel's size, has doubled during the one decade, and more than doubled during the next. If this rate of increase is kept up, the question arises, What kind of ships will be building when the century is two or three decades old? The dimensions would be so huge that one hesitates to put them down in sober print.

DECISION AGAINST THE BERLINER MICROPHONE PATENT.

In our last issue we referred briefly to the decision, rendered in the United States Circuit Court at Boston, Mass., on February 27, declaring to be void the patent issued to Emile Berliner November 17, 1891, No. 463,569, for a telephone transmitter.

This patent was previously sought to be annulled by the United States, on the ground of collusion and fraud between the holders of the application (the American Bell Telephone Company) and the Patent Office in delaying its consideration and issue. But the United States Supreme Court rendered a decision May 10, 1897, affirming the decision of the court below, stating that no fraud had been established, and dismissed the complaint. The merits of the invention were not touched upon, although facts were established proving beyond a doubt that Berliner had been anticipated.

One peculiar fact in the case is that the drawings in his first patent of November 2, 1880, were precisely the same as those of the 1891 patent, but the claims in the latter were enlarged to conform to the variable-pressure principle between the electrodes, then in use, and designed to cover a new art, method, principle or process. About this the opinion says: "The attempt to expand Berliner's unsuccessful experiments and caveat first into an invention, and next into a broad claim for an art, method, principle, or process, exhibits a remarkable degree of ingenuity, but is not convincing."

Having won its case on the fraud issue, the American Bell Telephone Company undertook to stop the use of the microphone transmitter, based on the 1891 patent, by bringing suit against two well-known competing companies, which has ended in the present decision.

The full text of the rescript of the decision by Judge Arthur L. Brown, declaring the 1891 patent void, will be found in the current SCIENTIFIC AMERICAN SUPPLEMENT, and is very interesting in its array of facts and reasoning by establishing the authorship of successful telephony.

A few of the points in the decision are that the patent is invalid because at the date of the application, June 4, 1877, the invention then described was different from the subsequent patented invention. His first description covers a make-and-break contact, and does not mention the constant contact, or variable-pressure idea, as stated in the final patent of November 17, 1891. His apparatus was similar to the old Reis, and because that could be made operative in the hands of experts, did not establish invention by Berliner.

As an inventor of apparatus, he cannot base a sole claim to invention founded upon an alleged discovery of a new capacity in old apparatus. He did not "embody" an invention in apparatus, unless he succeeded in making the old apparatus perform Bell's process upon the current.

Another point is that the patent of 1880 preceded and invalidated the second patent, and that the Commissioner of Patents exhausted his power to issue a second patent by issuing the first, though the title of the latter might appear to be different from the second.

A further ground is that Edison in his solid button transmitter patent antecedes all Berliner's dates, Edison going back to April 20, 1877.

Still another fact shown is that Bell's patents cover all forms of variable-contact transmitters. Bell's liquid transmitter and Edison's devices precede all.

In the following emphatic conclusion, the Judge says: "I am of the opinion that the defendant's transmitters are an invention substantially distinct from that disclosed in the Berliner patent; that the conception of Edison of the use of carbon for speech transmission preceded Berliner's conception of the use of solid, metallic electrodes; that, from his first conception, Edison diligently proceeded upon a line of experiments that led to an invention of remarkable character, which borrows nothing from Berliner, has no substantial resemblance to what is shown in the Berliner patent, and cannot be identified with it by any ingenious use of language. The defendants owe nothing to Berliner."

While it is probable an appeal will be taken to the United States Circuit Court of Appeals, it is not likely, in view of the evidence disclosed in this case based on well-known historical facts and documentary proof, that this decision will be reversed. The decision can have none other but a beneficial effect upon all telephone enterprises, including manufacturers and telephone companies. The rapid expansion and use of the telephone in many fields in the future may now be predicted with an economy in cost at present claimed to be unattainable.

CURIOSITY AND SCIENCE.

Curiosity, it may be safely said, is the handmaid of science. And to the men who have found something mysterious in the common occurrences of life, and whose curiosity has been sufficiently aroused to unravel the mystery, we owe much of the progress we have made along almost every line of thought. It is true that the explanation of the mystery may require an extraordinary logical power and an imagination with which not all of us are blessed. But, nevertheless, the process of reasoning which has led to the greatest discoveries may be largely attributed to the very human impulse of inquisitiveness.

No doubt many a man before the time of Columbus had remarked the exotic fruits and branches tossed up by the waves of the Atlantic on the shores of the Canary Islands. Such fruits had never been seen in the Old World; yet the islanders had picked them up from time immemorial with never a thought as to whence they might come. But the Genoese mariner had both curiosity and imagination. To him these strange gifts of the sea became messages sent from a land which no European ship had ever touched. It may be that he was mistaken in his conception of that land; but the fact remains, if the story can be credited, that then the voyage of exploration which culminated in the discovery of the New World was first planned.

Then we have Newton's apple. It matters little whether or no the apple did fall, or opportunely strike Newton while he was sitting in his garden. Things have fallen ever since the universe was created. And yet no man seems ever to have asked himself: Why?

Robert Mayer, a ship's surgeon, cruising in the East Indies, noticed that the venous blood of his patients seemed redder than that of people living in temperate climates. Doubtless other physicians had also noted the fact. Mayer pondered over this apparently insignificant difference in venous blood and reached the conclusion that the cause must be the lesser degree of oxidation required to keep up the body-temperature in the torrid zone. And it was this conclusion which finally induced him to look upon the body as a machine driven by external forces. The thought led to the discovery of the mechanical theory of heat and to the first comprehensive appreciation of the great law of the conservation of energy. Blood-letting is a time-honored practice which is now fallen out of favor. But an inquisitive and discerning physician deduced from it conclusions so marvelous that he has been called "the Galileo of the nineteenth century."

Chemists speak familiarly and learnedly now of the law of substitution by which they are enabled to explain so many of the eccentricities of carbon compounds. The discoverer of that law was a curious Frenchman named Dumas, who was once invited to a court ball given at the Tuileries. A strong and penetrating odor pervaded the royal ballroom. The guests coughed and sneezed. Dumas also coughed and sneezed, and wondered why. He tells us that he finally recognized the odor as that of hydrochloric acid, and found that the wax tapers by which the ballroom was illuminated had been bleached with chlorine. Ex-

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periments which this discovery subsequently induced him to make proved to him that for the hydrogen in organic compounds other elements could be substituted, atom for atom, and that every organic compound was, therefore, a step to every other organic compound. No generalization has contributed more to the progress of organic chemistry than this law of substitution.

Such anecdotes can be told *ad infinitum*. Enough have been given to show clearly how simple things are often straws which have guided the current of scientific thought to epoch-making discoveries.

EROS, THE CELESTIAL RANGE FINDER.

The first stage in a fresh attempt to compute with accuracy the sun's distance from the earth is now drawing to a close. For six months or more the astronomers at fifty observatories, well distributed over the globe, have been making photographs of the sky, which would show both the tiny asteroid Eros and a few stars in its vicinity. At many of these institutions the weather has permitted work on fifty or sixty nights, and as often as possible two pictures have been made, one early in the evening and the other just before dawn. Sometimes one has been taken at midnight, too. In the aggregate, fully 5,000 or 6,000 plates have now been exposed.

The next important step in the enterprise will be the measurement of the photographs, to ascertain the distance, in minutes and seconds of arc, between the asteroid and the neighboring stars. And then a number of comparisons must be made. One will show an apparent difference in the position of Eros at a given moment, due to simultaneous observations from places that are widely separated, like Pulkowa and Washington. Another will reveal a similar shifting, in consequence of a single observer's change of position through the rotation of the earth. Finally, with the two sets of base lines thus obtained, triangulation will give the distance of Eros from the earth, in miles, at a number of points along its orbit. The ratio between the asteroid's distance from us and the sun's having been ascertained—and this is an easy matter—the rule of three will tell us how far away the sun is. This distance, though closely approximated, has never been determined, with precision, and yet it is the celestial yardstick by means of which all others are compared by the astronomer.

The method here described is an old one. The moon and the nearest planets, Venus and Mars, have been utilized in the same way to solve the great problem of the sun's distance, but unforeseen difficulties have embarrassed each of these ventures. Eros, though much smaller—it is probably not more than twenty miles in diameter—is much more available. Its place can be determined with greater exactness. Besides, at times it comes nearer to the earth than do Venus or Mars, a fact that facilitates accuracy in measurement.

Eros was discovered scarcely more than three years ago. Something like 450 other asteroids are known. But, with the exception of the first few, none of them created such a sensation as the one which, temporarily designated "D Q," was subsequently named after the Greek God of Love. The reason for this peculiar interest is its remarkable orbit. Most of the asteroids keep entirely outside of that of Mars—the planet next beyond the earth in the solar system. But this little fellow's path not only overlaps the orbit of the ruddy planet, but it spends more than half its time inside. At one point the paths of Eros and the earth are nearly 60,000,000 miles apart, and at another they come within 13,000,000 miles of each other. The earth reaches the latter place every year, of course, and Eros gets there once in 21½ months. But unfortunately we do not both arrive simultaneously more than once in about forty-five years. Late in December last we came within 30,000,000 miles of the asteroid, and since that time we have been leaving it slowly behind. Yet, since there will not be so close an approach again before 1917, the astronomers have made the most of this opportunity. They began photographic operations early in the autumn, and now are about to end them. The undertaking has involved co-operation on an exceptionally large scale, and it will be consummated by months, perhaps years, of the nicest kind of mathematical work.

THE AUTOMOBILE IN THE KLONDIKE.

We have received some most interesting letters from John W. Fox, of East Cleveland, Ohio, in which he relates some notable particulars about the introduction of the automobile into Dawson City, the venture being in the hands of Edmund H. Clear and George W. Dunham, of Cleveland, Ohio. The machines are built like a three-seated surrey, each seat to accommodate four people. They are propelled by 15-horse power motors, and use about one gallon of gasoline per hour. They run on the trails and climb the hills without the slightest difficulty. They carry ten or twelve passengers each, and also have room for small packages for the different mining camps on the daily runs. The winter has evidently been a severe one in the Klondike, and this more than ever demonstrates the value of an automobile for an Arctic climate. In the United States we read frequently of deaths from freezing at temperatures nearly a hundred degrees warmer than are found in the Klondike. During the last 187 miles of the journey of Mr. Dunham, the temperature ranged from fifty-five to seventy-one degrees below zero, and the government thermometer registered seventy degrees below zero for three days in Dawson City. Mr. Dunham says: "I started up the river December 30, and did not get back until January 21, being delayed by a run of cold equaled by nothing experienced by the old inhabitants. For over a week the temperature never rose above fifty-five below zero, and one time was as low as seventy-two. We traveled every day, however, going slow, making from five to twelve miles, according to the conditions of the trail. To make matters worse, the horses' nostrils would clog up with frost, and had to be cleared from time to time when they began to stagger for want of air. Our loads consisted of two four-horse teams, pulling about 5,000 pounds each, and the wagons were 9½ feet wide, so you see we had to chop ice wherever it was rough. Some nights we did not go into the roadhouses until nearly twelve. We have one machine erected, and we take it out every day, and are getting it in pretty good shape. Dawson is highly excited, and every one is urging us to hurry so they can ride." Another letter says: "The stage lines, or rather their owners, are beginning already to tremble, but after they see the 'gas buggies,' as one fellow called them, they will want to go out of business altogether, for the stages are only bob-sleds with seats, horribly cold and uncomfortable."

EXPERIMENTS WITH ANIMAL TISSUE.

The method of finding out whether a given animal tissue is living or dead, recently discovered by Dr. Augustus Waller, has awakened considerable interest. It will be remembered that this method consists in sending a current through the tissue in question, and then connecting it to the poles of a sensitive galvanometer, when a back rush of current is perceived in the case of living tissue, while in the contrary case no effect of consequence is obtained. Dr. Waller has recently made a series of experiments in which he follows out the same idea, but in this case applies it to discovering the first traces of life instead of its disappearance. In this he has been quite successful, and it will be interesting to follow a series of experiments made with eggs; up to the date of the present paper, three series of experiments upon eggs, good and bad, were made, and no exception was found to the general rule that a non-incubated, sterile, or putrefied egg did not give the back rush of current indicating the presence of vital phenomena, while an egg containing an embryo in a state of development always gave the indication which showed vitality. In the majority of cases, on account of the resistance of the shell of the egg to the passage of the current, a small portion was removed from the upper and lower sides, the egg being placed horizontally, and the electrodes (impolarizable) were applied to the membrane thus laid bare, so that the blastoderm floating at the upper pole was traversed by the exciting current. The eggs were placed in an incubating oven, which was regulated to a constant temperature of 37 deg. C. The following series of experiments shows the results obtained. First egg.—The egg at the beginning of incubation gave no back rush of current, but only small and negligible currents of polarization, which were in the contrary direction to the exciting current. Second egg.—After 24 hours' incubation the egg showed a small back rush of current, that is, ascending across the blastoderm. Upon opening the egg, it was found to be but little developed, with the vascular area scarcely apparent. Third egg.—After 48 hours' incubation, currents in the positive and negative direction were shown, of +0.0010 to 0.0022 volt and —0.0006 to 0.0012 volt. Upon opening, the vascular area was found to be well developed, and the heart beat vigorously. Fourth egg.—Incubation, 72 hours. The back rush of current was well marked in both directions. Upon opening, the normal development was observed. Fifth egg.—Incubation, 72 hours. In this case the results were negative. It was expected that a series of increasing currents would be found, according to the stage of development. In the present instance no current was obtained, even upon repeated trials; however, this apparently anomalous result was explained upon opening the egg, when it was found that no development had taken place, the egg being evidently sterile. Sixth egg.—After 72 hours' incubation, the normal reactions were given, with positive and negative currents of +0.0010 to 0.0019 volt and —0.0023 to 0.0026 volt. Upon opening, its development was found to be normal. The seventh and eighth eggs, with 96 hours' incubation, gave increased reactions of +0.0028 and —0.0044 volt; these were annulled by an elevation of temperature to 45 deg. C. The ninth egg, after 144 hours, gave a reaction of +0.0050 and —0.0025 volt, which was annulled by an injection of a 2.7 per cent bichloride of mercury solution. The tenth egg, after 12 days, showed no action, but only small currents of polarization of ± 0.0001 or 0.0002 volt. Upon opening the egg, it was found to be completely putrefied. This series serves as an example of a number of similar experiments which were made, with like results. It may be added that the effect was also observed in the case of eggs in the same mass such as frogs' eggs; the reaction has the same value for the two directions of the exciting current, being ± 0.03 volt; it is entirely effaced by heating to 40 to 45 deg. C. In the case of certain animalcules, which, when dried, seem to possess no sign of life, but in which, upon exposure to moisture, the vital activity is developed, the current indications follow the same order; in the first case no current is given, but upon the development of vital activity the characteristic current is always given. In the case of tissues, it was found that tissue which had been rendered insensible by anæsthetics gave no reaction, thus likening it to dead tissue. When the anæsthetic action was removed and vitality became apparent, the characteristic electrical reaction followed in all cases observed.

THE LONGEST SUBTERRANEAN TELEGRAPH CABLE IN THE WORLD.

The British Postal Telegraph Department has recently completed the laying of the underground telegraph cable, in place of the overhead wires, between London and Birmingham, a distance of 117½ miles—the longest underground telegraph cable in the world. The overhead telegraphic wire system in England, especially in the midland counties, suffers considerably from the effects of storms, notably in winter when the wires are often broken down by the weight of the snow, completely disorganizing the telegraphic communication for hours and sometimes days. In view of the fact that the principal great north trunk telegraph lines to Manchester, Liverpool, Glasgow and the other important industrial centers, radiate from Birmingham, some of the magnitude of the block caused by such a disruption of the lines may be conceived. Then again enormous expense is entailed in the constant repairs of the wires, since some disaster invariably occurs even in a moderate gale. In view of these circumstances the postal authorities determined four years ago to bridge over as far as practicable these exposed zones where overhead wires suffered so severely from storms, by laying the cables underground. The most important and largest section of this scheme proved by the survey to be that between London and Birmingham.

The cable consists of 76 wires, each of which is insulated in specially desiccated paper, and the whole inclosed in a leaden sheath to prevent the admission of moisture. It is laid in cast iron socket pipes, built in sections of 150 yards each. These pipes are buried at a depth of about 4 feet below the roadways, and where the cable passes beneath the pathways, at a depth of only two feet. The cable was manufactured in sections of 152 yards, thus leaving a yard at either end of the pipe sections, to enable the connections between the sections to be made.

When a section of pipes had been laid the drum containing the cable was brought to the end of the conduit, a pulling clip fixed to the end and the cable pulled through the pipes. As the cable passed off the drum into the pipes it was freely lubricated with petroleum jelly.

Great care had to be exercised in joining the sections, so that the insulation was rendered perfect. The lead covering at the ends of the two cables to be joined were first removed, to lay bare the ends of the conductors which were laid back in flakes to facilitate the process of separately joining each pair of wires. The joints were effected by means of a split copper tube tinned inside, with paper wrapped longitudinally round the exterior, and the wires secured tightly together with thread. No two joints were made in the same place, so that the wires did not present a bulged appearance at one spot. More paper insulator was then wrapped round and a lead sleeve pulled over the exposed wires and sealed up thoroughly at each end, so that the cable was converted into practically one length.

At intervals of five miles throughout the whole route, test boxes are placed on the roadside. They are built upon a foundation of 9-inch brickwork, set in cement mortar, forming an underground chamber through which the cable passes into the connection box inside the test pillar. By this means the individual wires may be tested and crossed quickly and readily.

At Weedon, which is a junction of several lines from the north, there is a test box where the wires cross from the open to the underground. When a breakdown, therefore, occurs beyond Weedon, the wires are immediately crossed, and the underground portion of the cable utilized, by which means all delays are avoided. The work has been executed throughout with great skill and care, so that the possibility of a breakdown between London and Birmingham is now very remote.

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THE MANUFACTURE OF OSTRICH FEATHERS.

The chief source of supply of ostrich feathers, the manufacture of which into "plumes," "boas," "tips,"

1. STRINGING THE FEATHERS TOGETHER FOR THE DYE.

"pompons," "trimmings," and the other odds and ends of decoration so dear to the feminine heart, affords employment to many thousands of operatives in this city, is the ostrich farms of Cape Colony. A few of the very finest feathers are brought from Egypt; and of late years the ostrich farms of Southern California and Arizona have contributed a small share to the general market. Ostrich farming, introduced into this country by Edwin Cawston, of South Pasadena, Cal., is a comparatively new industry in California, and

3. SIZING AND TRIMMING.

at first the feathers supplied to the market from this source were below the average. Of late years careful breeding and a more careful selection and care of the birds have produced a marked improvement, and to-day the feathers received from California are fully up to the standard.

The feathers are received by the manufacturers in New York in bundles of one hundred. The first step is to open the bundles, separate the feathers and tie them by their stems on strings, three in a piquet, ready for dyeing, Fig. 1. In the dye-house the strings of feathers are first washed in soapsuds made from common washing soap. They are then thoroughly scrubbed on an ordinary scrubbing-board, such as is used by washerwomen. Next they are put in a vat of red dye, Fig. 2, in which they are allowed to remain for four hours. After they have been taken from the vat, they are placed in a bath of black dye, in which the feathers are left usually for twenty-four hours, though the time may vary somewhat according to the quality of the goods. The dye vats, it should be mentioned, are heated by steam to a temperature of 150 degrees to 180 degrees Fah. After the black dye, the feathers are given a finishing brushing and scrubbing. They are then taken to a drying-room where the strings of feathers are hung up and exposed to a drying temperature of about 150 degrees for a period of six hours. As soon as they are dried, and before they are taken from the drying-room, the feathers are thoroughly thrashed out upon a board, the object being to thoroughly open up the flues and reproduce the feathery effect which is natural to the ostrich feather. It will be seen that the process of black dyeing is tedious and costly. Color dyeing, as it is known, in which the various tints such as light blue, pink, cardinal, etc., are given to the feathers, is much more quickly done, the whole process taking less than one hour.

2. DYEING THE FEATHERS.

Plumes and Tips.—After they have been dried and thrashed out, the feathers are cut off the strings and laid loosely in boxes and carried to a number of girls, before each of whom there is a wooden board graduated in inches, Fig. 3. The feathers are laid on these boards and sorted according to their size. They are then trimmed, the stems being shortened by taking off the rough, undesirable portion, and the head of the feather trimmed off.

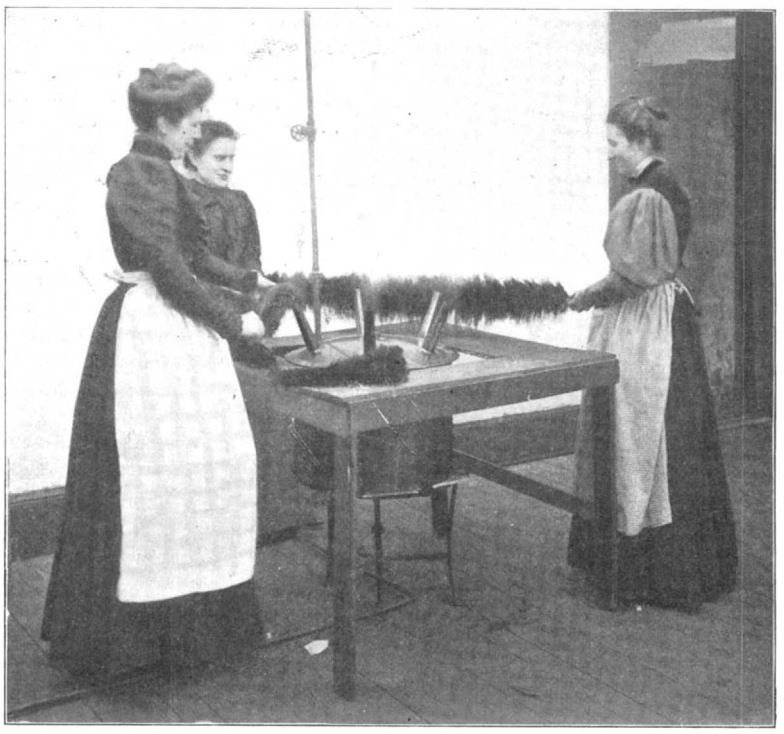
As the feathers are finished they are laid in little piles between vertical sticks according to their size. After sizing the feathers are graded according to their excellence, and put together ready for sewing.

A single ostrich feather, unless it be of very exceptional quality, does not have a sufficient number of flues to give it the mass which constitutes one of the beauties of a good feather. Hence, it is customary to place several feathers above one another and sew them together into one. To do this, however, it is necessary to remove the greater portion of the quill. The first sewer splits the feather in two, a process which is known as "parrying;" although in some cases, instead of splitting the feather, it is customary to slice off the quill. The ordinary grades of plumes contain three or four ostrich feathers, while the finest have five or six feathers. After they are assembled one above the other the feathers are stitched along the stems at intervals of an inch, the outer feather of all having the stem left intact and the others being sewed down upon it. The feather is now "stemmed," that is to say, an artificial stem of wire is sewn to it, and then it undergoes the important process of curling, as described below in connection with the manufacture of boas. The last work to be done upon the plumes is that of "bending," which consists of turning over the head of the feather so that the flues are heavily massed.

Feather Boas.—In the manufacture of feather boas the process is practically the same, with the exception that instead of the feathers being sewn down upon one another, they are sewn into continuous lengths of from one up to three yards, Fig. 4. The string of sewn feathers is then twisted above a steam kettle, as shown in our illustration No. 5, the object of the steaming being to render the flues flexible for the next process, which is that of curling. The curling

4. SEWING A BOA.

is done by gathering up a few flues at a time and drawing them over the blunt edge of a curling tool, whose blade is shaped something like a gardener's pruning knife; the flues as they are drawn over the blade are pressed down by the thumb, and although the



5. STEAMING A FEATHER AND TWISTING A BOA.

process looks very simple, as a matter of fact great skill is necessary to secure the desired curl. This is really the most expert work in the whole process of the manufacture of ostrich feathers, and the girls who are engaged in it, working on piece work, make in the dull season from $15 to $20, and in the busy season from $40 to $50 a week. The plumes are curled in the same way as the boas, some of them being curled over the stem, and others curled plain, or in the ordinary way.

Tips are manufactured in the same way as plumes, with the difference that the ends are more completely bent over, and the feathers are wired three in a bunch.

Pompons.—In the manufacture of pompons the feather is split so as to render it very pliable. It is then curled into a deep French curl, put together into a circle and tied with silk, an aigrette being placed in the center.

The feathers as they come to the manufacturers in the raw state are worth from $1.50 to $125 per pound, according to the quality. In the finished state they are worth from $7.50 to $144 per dozen. The cost of the finest feathers has been considerably reduced during late years, for only ten years ago they used to cost as much as $150 to $200 a dozen. At that time, however, feathers were not sewn or bent, and a single plume of the same mass and size as a high-priced sewn feather was very costly. The illustrations accompanying this article show the manufacture of feathers as carried out at the establishment of J. A. Stein, of 54 to 58 East 9th Street, New York city, to whom we are indebted for courtesies in the preparation of this article.

The Municipal Council of Paris has asked the Prefect of the Seine to forbid the throwing of paper streamers in the coming carnival, on the ground that they injure the trees as well as dirty the streets.

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THE OLD BOONTON FORGE.

The building of the great reservoir near Boonton, N. J., which is to furnish Jersey City with its water supply, will cause the final disappearance of one of the most famous landmarks of American history—Old Boonton Forge. This queer structure, half brick and half wood, lies in the valley of the Rockaway River, the river itself almost brushing its side in its journey toward the Hackensack. Directly across the country road which holds its uneven way toward Boonton is the old red house where Washington and Lafayette spent many weary days and weeks at various times during the New Jersey campaign.

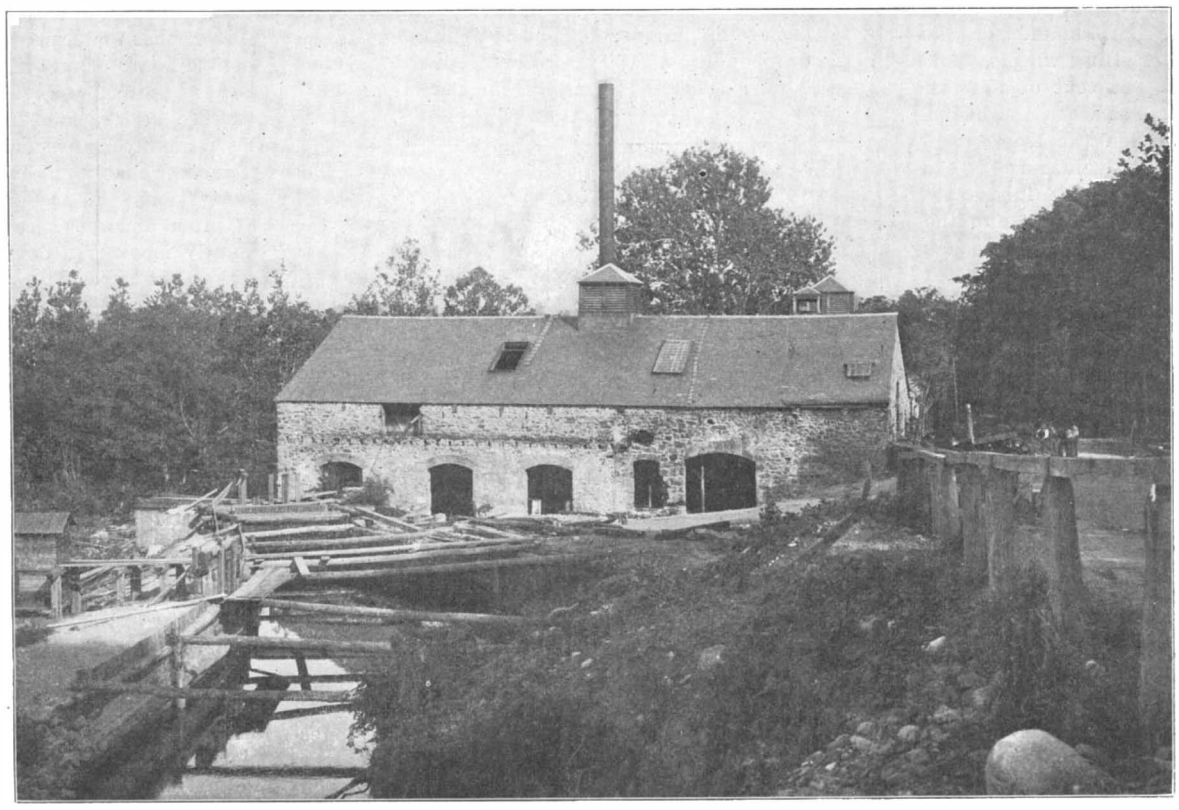
Just now the Forge is being used as a machine shop by the reservoir contractors, but in the latter half of the eighteenth century it held a place that was peculiarly its own. The structure was built in 1760, just about the time that the English Parliament issued an edict that no ironwork could be manufactured in the American colonies, and providing severe punishment for any one who violated the command. It so happened that the New Jersey people wanted some ironwork, and Boonton Forge was selected as the place of making. There had never been any ironwork manufactured in the colonies before, but it was executed in earnest at the Forge, and the work of manufacture went on without opposition until the Revolution broke out, being carried on with profound secrecy. The atmosphere about Boonton was exceedingly patriotic, and the people were extremely proud of the Forge, which they had dubbed "Liberty Forge." When Washington's men began operations in New Jersey it was found there was dire need of ammunition, and that the cannon would soon become practically useless because of the seeming impossibility of obtaining the necessary cannon balls. Then it was that the Forge entered upon its proudest days. There was a good deal of iron stored there, originally obtained for purposes of peace, but the consent of the owners was easily secured, and by Washington's order the fire of the Forge soon blazed in the work of casting shot to hurl against the British.

Hundreds of cannon balls were made and turned over to the Continental artillery before the patriotic work ceased, and it is current history that Washington said the task performed at Boonton Forge had much to do with the success of American arms.

Until the building of the reservoir began, the Forge was silent and untenanted, except when occasionally it was found useful for some special work that the equipment of the building lent itself to. It is lively enough to-day, but within a year's time the water of the reservoir will stand one hundred feet deep over its site.

The reservoir whose building has doomed the old Forge will be a notable work when complete. The land which it will contain is all of historic interest. Some of the farms included have been in the possession of the same families for two hundred years. The reservoir itself will be 2 1-7 miles long and 1½ miles wide at its longest and widest points, the total circumference being 10 miles. There are 200 acres of woodland to be cleared, and by January, 1902, everything above six inches in height upon the 970 acres of land that water is to cover will have been uprooted and carried away.

It will be necessary for the water to journey 23 miles after it leaves the reservoir before it reaches the Jersey City mains, the trip being made through a series of pipes and conduits. It will pass twice under the Passaic River, and once under the Hackensack. The construction of reservoirs and aqueducts for the water will when completed have occupied little more than two years. The work has a number of unusual features, but none are more interesting than the fact that it is the only reservoir so far as known that has for its site a Revolutionary battleground.



OLD BOONTON FORGE—A PRE-REVOLUTIONARY FOUNDRY WHERE CANNON BALLS WERE CAST FOR THE CONTINENTAL ARMY.

MOST POWERFUL EXPRESS LOCOMOTIVE IN THE WORLD.

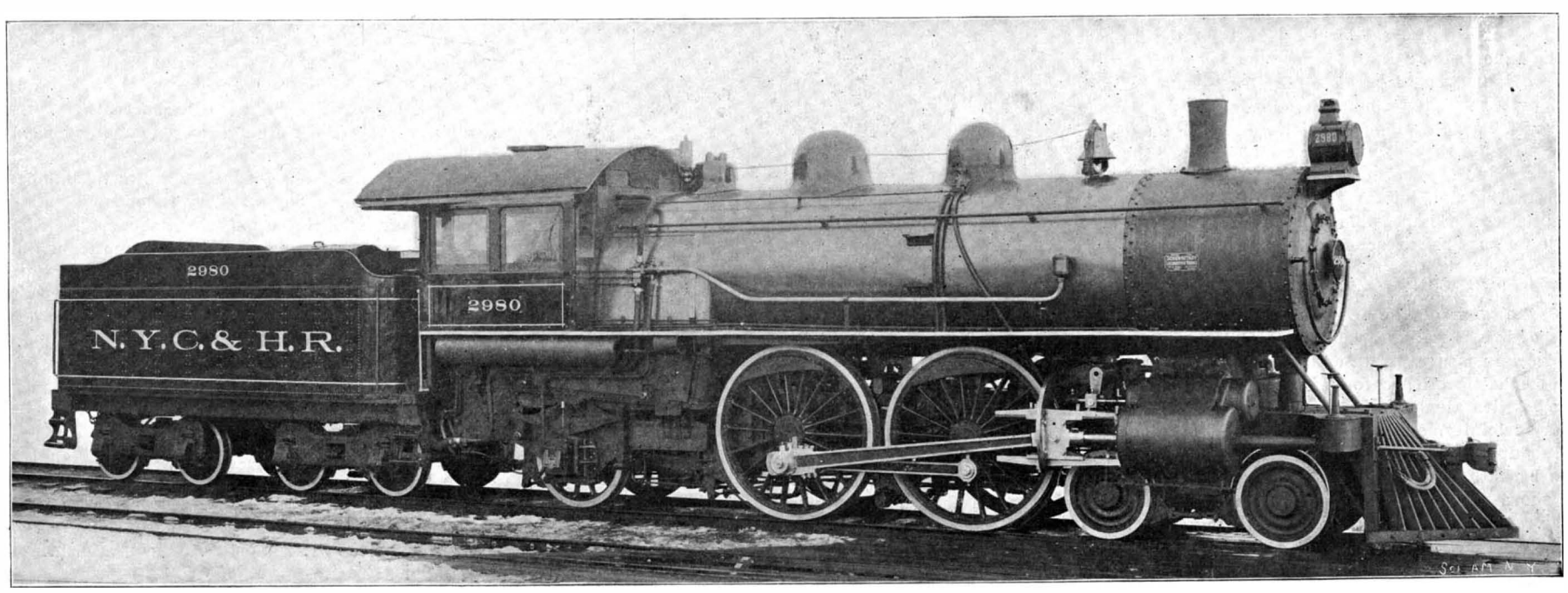
It is now nearly a decade since the New York Central and Hudson River Railroad Company introduced into its service a powerful express locomotive which, at the time, was probably the most efficient engine of its type in the world. We refer to the locomotive known as No. 999, a typical eight-wheeled, American locomotive, which, in those days, was distinguished from other American locomotives in service by the great size of its drivers, which were 7 feet in diameter, its large heating surface of 1,900 square feet, and a boiler pressure of 190 pounds to the square inch. This engine and its somewhat modified successors have been doing excellent work in hauling the Empire State Express and the fastest, long-distance trains of this railroad.

The rapid increase in the weight of trains, coupled with the utter impossibility of reducing the speed (indeed, it is certain that in the very near future our railroads will have to make an increase in the speed of their so-called fast trains), led the Superintendent of Motive Power of the railroad, Mr. Waitt, to design an express locomotive which is intended to haul heavier trains at the present rate of speed, or the same trains at a higher rate of speed, than is now accomplished. This engine, which forms the subject of our accompanying illustration, is of the very popular Atlantic type, which differs from the American type to which No. 999 belongs in having the four-coupled drivers placed well forward under the center of the boiler with the connecting rod coupled to the rear instead of to the front driver, a pair of trailing wheels being placed beneath the firebox, as shown in the cut.

The primary object aimed at in the new locomotive is to provide a huge boiler with sufficient capacity to insure a plentiful supply of steam at 200 pounds pressure under the most exacting conditions of service. The American type of engine, in which the firebox is carried inside the frames and between the axles of two pairs of driving wheels, necessarily imposes restrictions on the size of the firebox, and limits the grate surface and firebox heating surface. One advantage of the Atlantic type is that by the use of the small diameter trailing wheels, the firebox may be carried above the frames and project laterally beyond them, and there is no severe limit placed upon the length of the firebox, as there would were it carried between the driving axles. In the New York Central engine the firebox has an internal width of 6 feet 3⅜ inches, and a length of 8 feet, with a grate area of 50.3 square feet and a total heating surface of 180 square feet. The outside diameter of the boiler at the first ring is 6 feet, and it contains 396 2-inch tubes, which are 16 feet in length over the tube-sheets. The heating surface of the tubes reaches the enormous total of 3,298 square feet, and adding to this the heating surface of the firebox, and 27 square feet as the heating surface of the water-tubes, we have a total heating surface for the whole boiler of 3,505 square feet. This is by far the largest amount of heating surface ever given to a passenger locomotive, and it is only exceeded by the largest freight locomotives in the world, the Pittsburg, Bessemer and Lake Erie consolidations having 3,805 square feet.

It certainly looks as though the designer's expectation that the boiler will supply 200 pounds of steam in any quantities that the cylinders may call for will be easily realized.

As the cylinders are 21 inches in diameter by 26 inches stroke, it will be understood that when they are working up to full power an unusual amount of adhesion will be required, and to meet this emergency the engine is fitted with what is known as an adjusta-



Cylinders, 21 inches by 26 inches. **Drivers,** 79 inches diameter. **Weight of Engine,** 176,000 pounds. **Total Heating Surface,** 3,505 square feet. **Steam Pressure,** 200 pounds. **Tractive Effort,** 25,350 pounds.

THE MOST POWERFUL EXPRESS LOCOMOTIVE IN THE WORLD.

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ble equalizer fulcrum. This consists of a pair of levers operated by air cylinders, which are so arranged that when air is admitted to the cylinders and the levers are depressed, the fulcrum is shifted and a part of the engine load which ordinarily rests upon the engine truck and trailing wheels is thrown on to the drivers, thereby increasing their adhesion. The normal distribution of the weight of the engine, which in working order is 176,000 pounds, is 95,000 pounds on the drivers, 42,600 pounds on the truck, and 38,400 pounds on the trailers. On approaching a grade, or in starting, or when any supreme effort is to be made, the adjustable fulcrum is shifted and the weight distribution becomes 104,800 pounds on the drivers, 37,000 pounds on the truck, and 34,200 pounds on the trailing wheels. The normal traction, reckoned at 85 per cent of the full steam pressure is 23,725 pounds; but when the device just described is thrown into action the tractive effort is raised to 25,350 pounds. The valves are of the piston type, 12 inches in diameter with inside admission; the engines are of the simple type and the drivers are 79 inches in diameter. The tender has a tank capacity of 50,000 gallons of water and a coal capacity of 10 tons.

Altogether we must confess to a great liking for this beginning-of-the-century locomotive. It is strictly in line with the trend of developments in American locomotive designing, and as far as its contour and general appearance is concerned it is exceedingly handsome and impressive. The only criticism which we could make on this score is that the smokestack, though probably quite sufficient for its legitimate purpose, looks dwarfed and insignificant in comparison with the vast bulk of the engine. Our thanks are due to the Schenectady Locomotive Works for the photograph from which our engraving is made.

THE PITCH LAKE AND THE ASPHALT INDUSTRY OF TRINIDAD.

The island of Trinidad, which is the largest of the British West Indies, is 30 by 50 miles and lies in 10 degrees north latitude, 62 degrees 0 minute west longitude, and is separated from Venezuela by the Gulf of Paria and the narrow channels connecting it with the Caribbean Sea to the north and the broad Atlantic to the east, the island being apparently broken off from the mainland.

This island contains numerous asphaltic deposits. The largest and most interesting of this section, as well as of the world, is the one known as the "Pitch Lake." This is situated on the gulf coast or northern side of the western portion of the island, and lies inland about one mile. The topography of this portion of the island is irregular and rolling, and in the immediate vicinity of the Pitch Lake it is extremely simple, with the ground sloping gradually up from the sea to the Pitch Lake, which lies on the brow of a hill forming the end of a low ridge extending into the interior.

The lake lies at an elevation of 136 feet above the sea and covers an area of 114 acres, nearly circular in form, and lies on top of this hill in a basin-like depression that presents most convincing evidence of being the broad-mouthed crater of a volcano. The existence of mud volcanoes in this portion of the island and one small one about a mile to the southeast of the lake lends to the theory that this is the crater of an extinct mud volcano into which the asphalt has broken and filled it to the brim, and possibly at some prehistoric time has broken over the combing of the crater and flowed down toward the sea, filling on its way the hollows and pockets in the irregular surface and mixing with the dirt and other impurities on its way, forming what is known as land asphalt deposits. The rim of this crater is from 3 to 6 feet higher than the general level of the lake, the highest of the inner slopes of which are covered with a thin layer of sun-dried or dead pitch that seems to indicate that the entire mass has at some prehistoric time subsided. Borings show that the bottom of the lake is funnel shaped, as it is possible to bore through the mass and into the clay at a considerable distance in from the rim, but as the center is approached it has been so far impossible to get through it; a depth of 140 feet has been reached with no perceptible change in the nature of the material, and the deposit tapers from a thin sheet at the rim to the bottomless center.

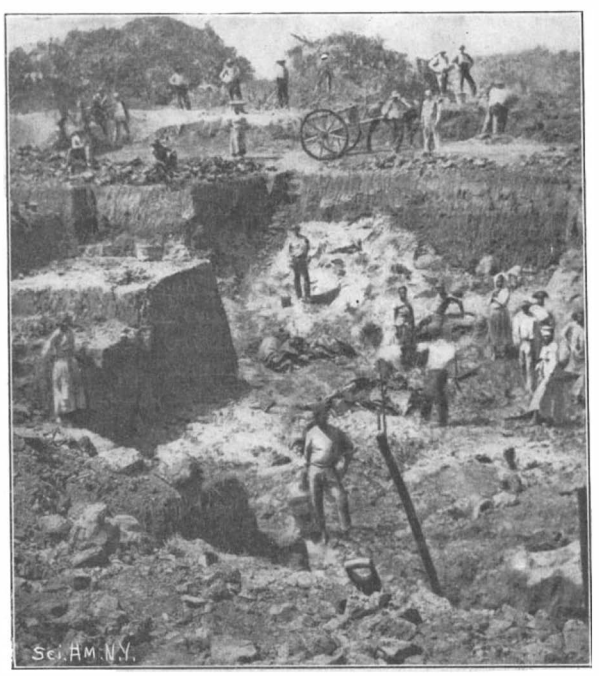
To the west of the lake, on the gulf coast, bold cliffs of bright red and yellow porcelainite with veins of porcelain jasper, strata of loose sandstone saturated with asphaltic oil are to be found for a distance of 4 or 5 miles along the coast. Two oil springs occur in this vicinity, one about 200 feet from the beach and about 40 feet above the sea; the other bubbles up from beneath the gulf at a similar distance out from the shore and spreads out over the surface of the water. Attempts were made at one time to separate the petroleum from the product of the former deposit, a company being formed for this purpose, but they were unsuccessful and soon gave it up.

The surface of the lake is not a continuous sheet, but is traversed by a series of crevasses or channels, which are connected into one system, that are always filled with water, and at times during the rainy season become 12 or 15 feet deep. These channels divide the entire surface into a great number of flat topped, slightly convex areas, many of which are nearly circular, and which resemble flattened cones. These areas each present a surface of concentric wrinkles, caused by the gradual sliding of the surface from the higher center toward the channels of water. The movement of these areas from the center outward is probably caused by a blow-hole or fissure in the underlying sandstone being directly under the center through which the pitch and gases are slowly issuing. Blow-holes that are much more defined occur in many places in the surrounding vicinity at distances varying from a few hundred feet to a mile from the lake. They

DIGGING AND LOADING ASPHALT ON THE LAKE.

are at times active, and small quantities of semi-liquid sticky pitch are forced up and build up small cones of 6 or 8 feet in diameter that spread out on the surface and form miniature pitch lakes, the pitch soon becoming hard by the evaporation of the volatile oils, leaving a small mass of pitch that is very largely mixed with the earth that it has gathered in its passage in what appears to be a small tube leading down to a larger deposit below, the surface of the ground being in most instances higher than the level of the surface of the lake.

The largest and most active of these cones is at the center of the crater, where semi-liquid pitch and gases are constantly bubbling up. This appears to be the main source of inflow and builds up a convex area of considerably larger proportions than its neighbors and is the highest portion of the entire surface, and is soft enough at the center so that a man will slowly sink



DIGGING LAND ASPHALT.

into it and would probably, in time, be engulfed. The gases that are emitted are sulphureted hydrogen, and give off a vile sulphurous odor and are inflammable, the bubbles burning with a slight explosion as a lighted match is held to them.

The water filling the channels is clear rain water, and nearly always holds in solution considerable sulphur absorbed from the pitch; in places this becomes of a decided acid reaction and will turn litmus paper. These mineral properties lead the native negroes to believe that it possesses medical virtues, and they come from some distance to bathe themselves in this veritable "Siloam."

Notwithstanding the mineral nature and the exceedingly high temperature of this water, which at times during the middle of the day is 140 degrees F., a peculiar kind of fish thrives here and grows to 8 and 10 inches in length. This water is also used for laundry purposes, and during the dry season the natives come from long distances, bringing their soiled clothing in bundles on their heads to wash in these pools of clear warm water.

The pitch is excavated for shipment by digging it up with a pick-ax, into pieces weighing 20 or 30 pounds, in patches of about 30 or 40 feet square, to a depth of 3 or 4 feet. As soon as work ceases on one of these excavations it begins to obliterate itself and come back to the original level. There is a slight closing in of the sides and a general rising up of the bottom, caused by the surrounding pressure and a slightly softer mass underneath the crust-like surface, and four or five hours of midday sun will bring it back to practically the same level, and as many days will obliterate all trace of it. There is no evidence of a higher temperature or of internal heat, and the plasticity is probably due to the oily matter it contains. The excavations and the movement caused by the inflow of pitch and gases cause the entire mass to be constantly moving in an irregular manner, and a line of stakes set across the lake with a surveyor's transit will in a few days be 8 or 10 feet out of line.

Numerous patches of vegetation, consisting in some cases of trees 5 or 6 inches in diameter at the butt, subsist on soil which has been accumulated in the crevasses. These islands, too, share in this general movement.

Statistics show that a lowering of 6 inches over the entire surface of the lake corresponds to the removal of about 100,000 tons, which is the approximate annual shipment.

An American company has a lease of this lake from the British government and is engaged in shipping the pitch to all parts of the world, to be used principally for paving purposes. Previous to 1894 it was dug out and loaded into carts and hauled to the beach, and from there lightered out to the ships lying at anchor in an open roadstead, but during that year a pier 1,700 feet long was built out into the gulf and an extensive loading plant was installed. The accompanying illustrations will help to give the reader some idea of this plant, which consists of a surface tramway running from a terminal power station, on the hard ground bordering the lake, run by an endless wire rope forming a loop around the center of the lake 4,000 feet long. Trains of three flat cars, carrying two iron tubs holding 1,000 pounds of pitch each and controlled by a gripman on each train, traverse this loop, stopping at the excavations to be loaded. At the terminal station these loaded tubs are exchanged for empty ones on a hydraulic lift that transfers them to an aerial tramway, which is also driven by an endless wire rope, and carried on steel towers down over the hill and out to the extreme end of the pier, where it is dumped direct into the hold of the ships laying alongside, the empty tubs returning on the other side of the loop. The surface tramway to the lake and the aerial tramway to the pier are coupled up to the same engine and the loaded tubs going down the aerial tramway by gravity help to run the entire system and a small engine developing about 20 horse power runs the entire plant. Each tub is weighed (and checked by a customs officer for the purpose of fixing the export duty collected by the government) on a scale block in the overhead track in the terminal station before being gripped to the hauling wire. About 175 tubs pass over this scale per hour, making about 80 tons per hour, or 800 tons per day, and employing a working force of 150 men. This plant was a revelation to the people of the island, and was a source of great surprise to them that it was a success, as they looked upon it as a wild scheme and predicted dire failure.

The labor employed is entirely of native negroes, who are not all that could be wished for. These people are ordinarily very contented and happy, with no thought of the morrow, and unless they are hungry they will laugh at a threat to discharge them. They require very little clothing, any temporary shelter will answer for a sleeping place, and they can subsist on sugar cane and fruit that grows in abundance about the island. They are very independent and extremely lazy, and clever only in dishonesty.

The management consists of five Americans. The dwellings of the manager and his staff and the office are built on the pier at a distance of 1,000 feet from the shore. The prevalence of malarial fevers in this portion of the island makes it impossible for a person accustomed to the northern latitudes to live on shore at night time without becoming impregnated with this dread disease that is omnipresent in tropical countries.

A coasting steamer that runs about the island calls at the pier three times a week, bringing local mails and supplies from Port of Spain, the principal city of the island, and at intervals of two weeks the steamers from New York and London visit the island, bringing mails from the outside world.

The site of the ancient Cyrene is being excavated by a Danish archæological expedition.

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Science Notes.

When once a milk bottle has been injured, be it in ever so slight a degree, says The New York Medical Journal, its future injury is likely to be speedy. Purveyors of bottled milk should be warned that every bottle with a chipped mouth should be discarded.

The Department of State has received a note from the legation of Sweden and Norway, dated Washington, February 2, 1901, stating that the managers of the Nobel Fund, of Stockholm, have been authorized to correspond directly with interested parties abroad without using the channel of the Ministry of Foreign Affairs at Stockholm.

At a recent meeting of the Academy of Medicine, Dr. Jarre announced the discovery of a remedy for the foot and mouth disease, which is so fatal to sheep. He says he has successfully used the remedy in 1,500 cases in two years. It consists of a concentrated solution of chromic acid at 33 per cent chemically pure. This is employed as a caustic to the sore. The cure is rapid and certain. Dr. Jarre says that M. Dupuy, Minister of Agriculture, has promised to give the remedy official tests.

Armour & Co. closed, on March 4, the largest contract for supplies for a polar expedition ever taken by an Arctic explorer. The contract was awarded by Evelyn B. Baldwin, who will head the expedition to the North Pole which will start about June 1, and will consist of 200 tons—ten carloads—of specially prepared food-stuffs, which it is expected will last Baldwin and his party twenty-seven months. The value of the supplies is between $50,000 and $60,000. The supplies are to be delivered in New York by April 1, and will be shipped thence to Dundee, Scotland; Tromsoe, Norway, and Sandifiord, Norway.

Consul Hughes, of Coburg, says that Prof. Pictet, of Geneva, is reported to have devised a plan by which oxygen can be produced on a commercial scale and at a cost that will greatly increase its use. By this method air is admitted into a condenser, the condenser being cooled by liquid air. The low temperature causes the oxygen to separate by gravity from the nitrogen of the air. It is then drawn off from the bottom of the condenser, and the nitrogen from the top, while any carbonic acid present, made liquid by the low temperature, is drawn into tubes. As a 500 horse power engine will make 500,000 feet of oxygen a day, it seems that the process is not expensive.

Prof. J. B. Steere, who is well known to readers of the SCIENTIFIC AMERICAN by reason of his valuable papers on the Philippines published in this paper during the late war, has been sent to the Amazon to make a collection of the fauna of that region. Each specimen will be prepared on the spot instead of preserved in alcohol as heretofore, and will be shipped in time to be exhibited at the Pan-American Exposition. Prof. Steere, who, by the bye, is a celebrated ichthyologist, experienced great difficulty in securing passage. He engaged transportation in one vessel, but on arrival in New York he found that the vessel had no license to carry passengers. He signed articles at once and shipped as purser. The energy of American scientific men is to be commended.

The London Standard has been advocating the manufacture of beer from beet roots. A large farmer in the southwest of England has been carrying out experiments for several years for the distilling of brandy from this product, but the results were not encouraging. Other experimenters, however, have been more successful in their efforts, and it appears extensive preparations are being made to give the suggestion a thorough practicable trial. The beet abounds in the sugar juice, but it is stated that the cost of separating it from the gums, acids, and salts is somewhat expensive and would result in a higher price being charged for the beer. On the other hand, the principal recommendation in its favor is that its utilization would dispense with the employment of those dangerous substances conducive to arsenical poisoning.

A project is on foot for the retention for a number of years of twelve out of the sixteen buildings on the Street of Nations, of the Paris Exposition. With the exception of those representing Italy, Spain, Turkey and Servia, the buildings were found to be sound. It is proposed to establish a Museum of Comparative Education in the United States Building, and in the Austrian Building an exhibition of the international exhibitions between 1798 and 1900; the Hungarian Building will be assigned to the history of civilization; the Belgian Building will probably be used as a Museum of National Art; the Norwegian pavilion will contain objects relating to navigation and marine exploration; the German Building will be devoted to learned societies; the Swedish Building will be converted into a Museum of Manual Instruction, and the building of Greece, if it can be retained, will be used to show the recent discoveries in classical architecture. The building of Finland will be devoted to geography, and of Monaco to oceanography. The building occupied by Great Britain will be reserved for sanitary science and bacteriology.

Engineering Notes.

A speed test was recently made with a wood pulley 46½ inches in diameter, 16 inches face and bored for a 4-inch shaft. A total rim speed of 28,889 feet was attained, the pulley showing no signs of giving out at this high speed.

Men who are enlisted for service in the navy are not to be assigned to service in submarine boats without their consent, and the Bureau of Navigation will recommend that special service enlistments for these vessels be authorized.

In the Washington navy yard there are scales with a capacity of 150 tons, but it has been found that they will weigh much more than this, and two 13-inch guns have been weighed with accuracy. The platform of the machine is 48 feet long and 12 feet wide.

The Pennsylvania Railroad will spend about $2,500,000 for new locomotives during the current year, and the Baltimore & Ohio will spend $1,300,000 for the same purpose. The Pennsylvania has authorized the construction of 204 new engines, and all but about 50 will be built in the railroad's own shops.

French engineers are again considering the advisability of bringing an adequate water supply from Lake Geneva. The supply is practically inexhaustible and the water is extremely pure. It is thought that the total cost of the undertaking would be $200,000,000, including $25,000,000 which the Swiss government would require.

Manufacturers of projectiles and armor plate are experiencing exceptionally busy times in England. The war in South Africa has had the effect of depleting the military department of their heavy stocks of war stores, and consequently it will take a long time to fully replenish them. It has also been decided to reorganize the artillery section of the British army, and to equip it with the latest and most powerful type of guns. Several orders for this new armament have been already placed and the manufacturers are working at full pressure in order to deliver the contracts within the specified time.

An interesting sight at the yards of Denny Bros., shipbuilders, is a flying machine, which the Dennys are confident will be very successful, says the New York Sun. It looks much like Zeppelin's airship, and was designed by a Spanish youth mainly as an engine of war. It is intended to rise to a great height and drop explosives. The Dennys are also building the first turbine passenger ship, which was designed by Parsons, of Glasgow, for a syndicate of shipowners. The boat will ply between Greenock and local pleasure resorts. She will have a speed of 27 knots an hour.

Some two years ago a Mr. Henry W. Wing, of Boston, Mass., devised a new spinning machine, which he took with him to Bradford, the center of the spinning industry of Great Britain. There, aided by local engineers and experts, he improved his appliance which is now in active operation. It is capable of spinning a variety of materials, such as asbestos and peat moss, as easily and as readily as wool, and when completed it is difficult to determine the original nature of the fabric. The apparatus will be specially useful for the spinning of flax waste, which hitherto has been considered almost a waste product, and as such has been sold for paper-making. By this means, however, it will be spun into a more profitable commercial article.

An interesting statistical return has recently been compiled showing the remarkable growth of railways in Great Britain from 1872 to 1899. In the former year 15,814 miles of railways were in operation, while in 1899 the mileage had increased to 21,700. The gross receipts derived from all the railways in 1899 exceed those of 1872 by over $242,157,675. On the other hand, working expenses have increased to the extent of $169,065,235. The third-class passenger traffic is the principal source of revenue, the number of first and second-class passengers for the year 1899 showing a decrease of 3,469,856 and 3,972,491, respectively, in comparison with the returns for 1872. The average dividend earned by the railways in 1872 was 4.74 per cent, and it has now decreased to 3.61 per cent for 1899.

The British Naval Department have just placed orders for the construction of two first-class battleships of the "Majestic" class to be named respectively "Queen" and "Prince of Wales;" six armored cruisers, two second-class cruisers of the "Minerva" type, and two sloops. The two first-class battleships are to be built in the government dockyards at Devonport and Chatham. They will each be of 15,000 tons, and a speed of about nineteen knots per hour. The cruisers, two of which will be undertaken by the government, three in private firms on the Clyde, and the sixth at Newcastle on Tyne, will measure 440 feet in length, beam 66 feet, draught 24 feet 6 inches, displacement 9,800 tons, engines 22,000 indicated horse power, and speed 23 knots. The second-class cruisers will have a speed of 20 knots (which, by the way, has been considered insufficient for this type of craft by naval experts), and will, together with the sloops, be built in the royal yards.

Automobile News.

The attention of all United States Inspectors of steam vessels has been called by the Treasury Department to the recent act of Congress, by which automobiles using gasoline may be transported on ferryboats or other steam vessels. The amendment to the Revised Statutes, passed by Congress shortly before the adjournment, provided that nothing in the statutes should forbid the transportation of these vehicles, provided the flame used in connection with the motive power be extinguished while the vehicles are on the vessel. It was provided, however, that the owner or master of a vessel may legally refuse to transport vehicles containing tanks of gasoline or other explosive liquid, if he is disposed to do so.

The question of automobiles for army use has not received the same attention in England as it has among other nations of Europe, especially France, Germany, and Italy; it is, however, being considered favorably by the authorities. It appears that a member of the Automobile Club of England proposed to the War Office to organize a volunteer corps of automobiles for the present campaign. He received the following reply: "The Secretary considers that the time has not yet come for organizing a special corps, although it is disposed, in case of urgence, to call upon the good-will of the authors of the proposition. He would be glad to have them furnish all the information relative to the number of machines to be disposed of and the services which they can render, indicating the speed, the maximum load, the weight, and the consumption of each machine."

The Geographical Congress of Italy, which will be held at Milan, from the 11th to the 14th of April, has authorized the Touring Club of Italy to organize a special exposition of the methods of locomotion used for long voyages during the nineteenth century. The Touring Club has received the idea with enthusiasm, and it will endeavor to make this exposition as complete and as interesting as possible. In the collection will be found a series of maps of different periods, guides, notices relating to the various means of transport, railroads, tramways, boats, cycling and automobile, as well as the subject of aerial navigation. The exposition is in charge of M. Bertarelli, one of the most efficient members of the club. At Milan a series of electric automobiles have been recently put in service as cabs, and it is thought that the system, after it is well started, will prove quite successful.

The programme for the Tour of Italy, which will take place next May, has been definitely fixed by the organization committee. The Tour is divided into two categories; the first includes the whole of the route laid out, or about 1,000 miles, and the second includes Florence-Rome-Milan, 660 miles, or Naples Rome-Milan, 640 miles. The engagements close on the 15th of April; for the first category the sum fixed is $15, and for the second $10. Each of the competitors entered for the Tour is to receive a handsome badge, and a special art prize will be offered for each vehicle. An employé specially charged with the baggage is to follow the tour by railroad, and the conductors are to be furnished with coupons for lodging and nourishment at reduced rates. The itinerary is given as follows: 1st day. Turin, Asti, Novi, Genoa, 106 miles. 2d day. Genoa, Chiavari, Spezia, 65 miles. 3d day. Spezia, Pisa, Florence, 99 miles. 4th day. Florence, Sienna, 100 miles. 5th day. Sienna, Grosseto, Civita Vecchia, 125 miles. 6th day. Civita Vecchia, Rome, 42 miles. The seventh day will be spent at Rome. 8th day. Rome, Civita Castellana, Terni, 60 miles. 9th day. Terni, Perugia, 54 miles. 10th day. Perugia, Scheggia, Pesaro, Rimini, 112 miles. 11th day. Rimini, Imola, Bologna, 67 miles. 12th day. Bologna, Ferrara, Padua, 74 miles, with promenade to Venice. 13th day. Padua, Verona, Brescia, 89 miles. 14th day. Brescia, Lodi, Milan, 60 miles.

The New Star in Perseus.

A circular has just been issued by Prof. E. C. Pickering, director of the Harvard Observatory, which supplies further information concerning the first observations of Nova Persei at that institution, and incidentally corrects certain false interpretations that have been put on the bulletin of February 22. The latter, after announcing that the new star was then of the first magnitude, added: "A photograph of this region taken on February 19 showed that it was fainter than the magnitude 10.5. This result was confirmed by photographs taken on February 2, 6, 8, and 18."

The inference has been drawn from this phraseology that, although not so bright as a star of magnitude 10.5, the Nova was, nevertheless, visible on all of the dates specified, but that it increased suddenly in brilliancy between February 19 and 22. But the circular just published makes it clear that the star was not found on any of the plates prior to Dr. Anderson's discovery, although other stars as faint as the eleventh magnitude were there. Its history begins with February 21, therefore.

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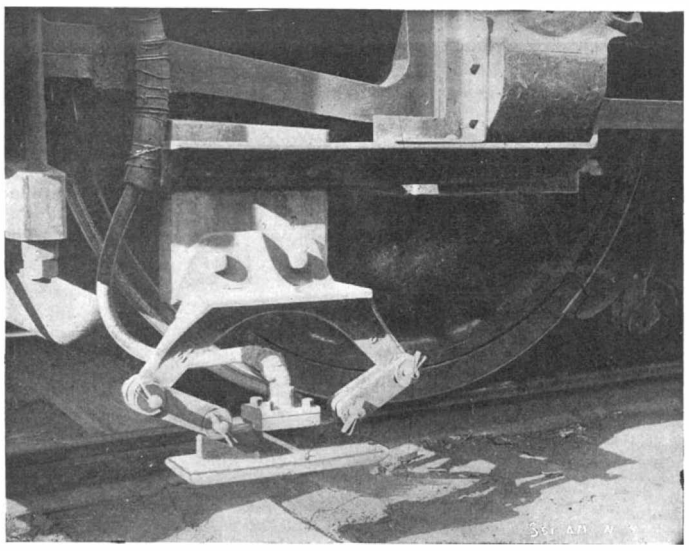
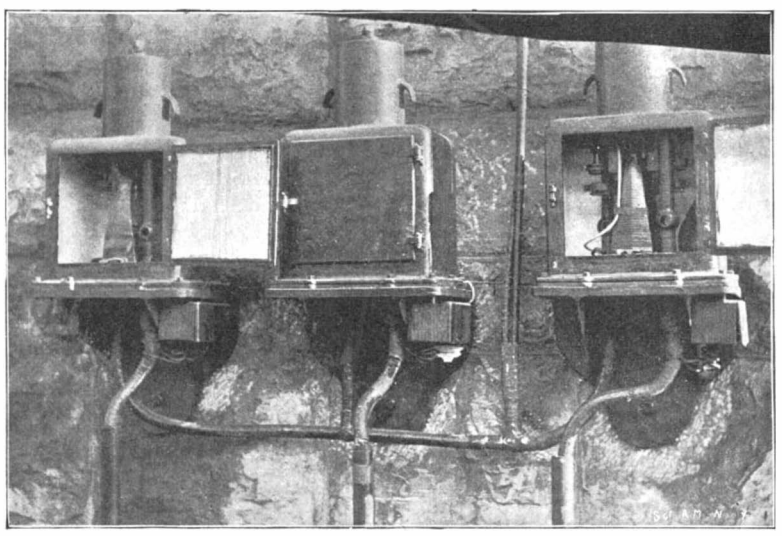
THIRD RAIL IN THE BALTIMORE BELT LINE TUNNEL.

A few years ago the Baltimore & Ohio Railroad Company spent about $7,000,000 in constructing a railroad through the city of Baltimore and its suburbs in order to save about half an hour in time and to secure an all-rail route from the metropolis to the capital of the country. Before the Belt Line was built passenger and freight trains were carried across the harbor on a huge car ferry named after the founder of the Baltimore & Ohio system, "John W. Garrett." The Belt Railroad cost nearly $1,000,000 a mile to build and equip, owing to the large amount of tunnel construction and other difficulties of the work, also to the fact that it was to be operated by both steam and electric service. It was the first railroad of any importance in the world to utilize large electric locomotives for hauling freight and passenger trains.



CURRENT-TAKING SHOE.

The use of electricity was decided upon for the reason that the Belt Line contains several heavy grades and has some of the sharpest curves of any railroad in the United States. To furnish the current, a power house was built from which the electricity was transmitted by cables to an overhead conduit system, consisting of a metal trough hanging from iron bars, which were in turn supported by metal archways located from 200 to 300 feet apart. A "shoe" made of cast iron slid through the trough, passing the current to the motors by means of an adjustable metal bar, which connected the shoe with the top of the electric locomotive. In the tunnels the conduit was supported from the roof without the necessity of the archways, but it was found that a large quantity of the current passed to outside conductors in spite of the insulated protection, and this leakage necessitated the generation of much more electric power than has been actually needed to work the motors. The overhead system has also required a considerable outlay yearly for repairs, and for some time past the Baltimore & Ohio management has been considering the adoption of some other mode of electric transmission, especially as it wishes to use electric traction on about 70 miles of what is known as the mountain division in Maryland and West Virginia, where ordinary freight trains require two and three of the largest steam locomotives to carry them over the grades. For the last six months the work of equipping the Belt Line with what is known as the third rail, also the sectional third-rail system, has been in progress. In the tunnels and in the vicinity of the railway stations the sectional system is used for a distance of 3½ miles, the third rail covering the balance of the Belt Line. Its installation is similar to the system on the New York, New Haven & Hartford Railroad between Boston and Nantasket Beach, but more current is required on the Belt Line. It is conveyed through an extra or feed rail laid about 18 inches outside of the regular track. This weighs between 70 and 80 pounds to the yard and is bonded by insulated copper cables fastened into the ends of each rail. The current from the power house is also carried to the end of the feed rail by cables which are buried in the ground. The electrical locomotive takes its power by means of a shoe which slides along the top of the rail. Each locomotive has four shoes, fastened, one outside the lower part of each driving wheel, and connected with the locomotive frame by spring attachment that adjusts itself to any deviation in the track, so that the shoe is automatically held upon the rail. The sliding shoe is utilized on both the third rail and sectional portions. Only the portion of the sectional third rail, however, is charged with electricity that is covered with the locomotive. It receives its name from being divided into sections controlled by electric switches, which are automatically operated by the movement of the locomotive.



AUTOMATIC MAGNETIC SWITCHES.

The switches are practically of the solenoid type with two windings, one a fine winding, taking a current of about 550 volts from the generator on the electric locomotive, through the controller, the contact shoes and the third rail. This current raises a plunger, which closes the switch and feeds the power house current of 700 volts to the third rail. The moment the weaker generator current passes through the fine winding and closes the switch, current from the power house passes through the heavy winding of the magnet and keeps the switch closed until the contact shoes of the electric locomotive have passed to the next section. The circuits around the magnet being broken, the switch opens by gravity. The contacts last to operate are of carbon, and the spark, if any, is between these contacts, thus preserving the metallic contacts from injury. At the instant the contact shoe at the forward end of the locomotive comes in contact with the forward section of the third-rail conductor, the switch controlling the feeder for that section closes, and the switch for the rear section opens.

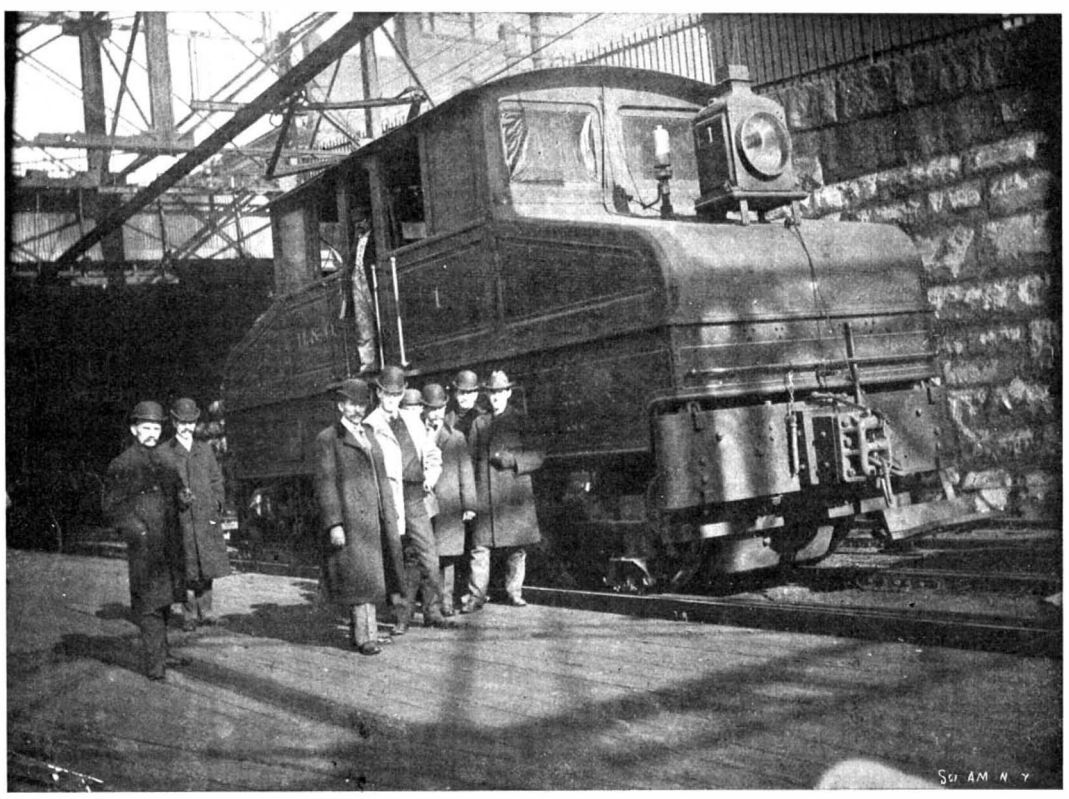
Each of the magnetic switches is provided with a single pole double throw knife switch in series with the fine winding of the magnet. This is used by the inspector to test the magnetic switch and ascertain whether it is in proper adjustment. Should it be necessary to make any adjustment while the section controlled by the switch is in use the current is fed to that section by means of a temporary bridge which he places in position.

In operating the motors, the motorman turns the controller to the first notch, opening the throttle to the air engine, which, taking compressed air from the storage reservoir of the air-brake system, drives an electric generator, which generates sufficient current to operate the magnetic switch and charge the third rail with current from the power house. At the instant the magnetic switch is closed the power house current passes through it to the third rail, thence through the contact shoe and the controller to the electric generator which operates the switch, and also to the four 300 horse power motors of the electric locomotives. Immediately and automatically the generator becomes a motor, operated by current from the power house, and drives the air engine as an air compressor, recharging the compressed air reservoir from which the air engine originally obtained its power.

At no time is it possible during the operation of this system to have a charged conductor or third rail except when the motorman has turned the controller, and then only one section is charged, i. e., the section on which the electric locomotive is operating.

The locomotives in use on the Belt Line have hauled by the overhead system two loaded freight trains with their engines, representing about 2,500 tons of weight, unaided by the steam locomotives. This will give an idea of their transmission power. The same amount of current required for this pull has been transmitted by means of the sectional and third rails to the locomotives during the present tests without difficulty. The archways and conduits of the overhead system remain and the locomotives can take current as desired, either from the top or bottom. The accompanying photographs show the overhead connection, but the motive power is coming entirely from the shoe which can be seen connected to the third rail. The upper construction is to be removed in the near future.

The tests which have been made include the operation of the locomotives at slow, half and full speed with and without loads. They have been switched from one track to another, started and stopped on grade and placed in service to haul a train of twenty-



ELECTRIC LOCOMOTIVE TAKING CURRENT FROM THE THIRD RAIL.

THIRD RAIL SYSTEM IN MOUNT ROYAL STATION.

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two 45-ton coal cars loaded during a heavy snow storm, the shoes taking current from the rail when covered with snow and ice to the depth of several inches. In adapting the motors for service with the systems, the mechanism was practically unchanged, a few alterations being made to the air compressors and the contact shoes connected as shown in the illustrations.

Both the sectional and third-rail installations were completed under the supervision of Mr. John McLeod Murphy, inventor of the sectional method and chief engineer of the Murphy Safety Third Rail Company.

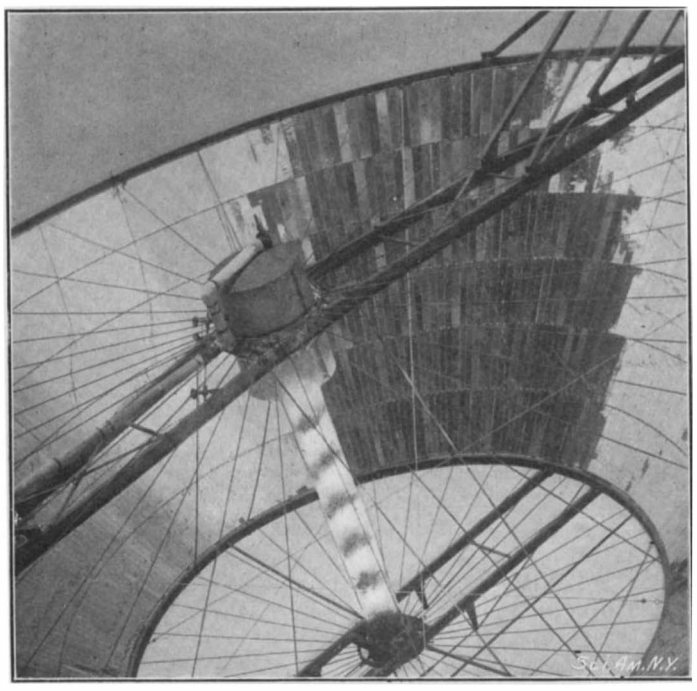
SOLAR MOTORS.

BY CHARLES F. HOLDER.

For many years the attention of inventors has been directed to the question of utilizing the direct rays of the sun as a substitute for coal, wood, or other fuel; large burning glasses or reflectors being the general form of the various machines. Especially in France have these been seen. A so-called "burning mirror," made by a Frenchman named Villette, was four feet in diameter, and produced so intense a heat that, according to the report, it melted cast iron in sixteen seconds. The heat resulting from the sun's rays is remarkable. An Englishman, one Parker, years ago built a lens about three feet in diameter, which melted a cube of cast iron in three seconds, and granite was fused in one minute. This result was produced from a concentrating surface of seven square feet; which suggests that if the reflector could be made so that the field of concentration would be a square mile the iron would melt in less than a millionth of a second, suggesting the possibilities in this direction with enormous reflectors, or groups of small ones.

It was for a long time difficult to build a concave mirror of very large size, but this was finally overcome by having the surface of the concave mirror covered with small pieces of glass, or mirrors, each of which is so placed that the light or reflection from each side is thrown upon the same spot, the sum total, or the amount of heat centralized, being equivalent to the amount reflected by each glass, multiplied by the number of mirrors. In Europe the early solar glasses were generally of two kinds; that is, the heat was concentrated in two ways—by reflection from polished concave mirrors and by refraction through a convex lens. The earliest use, centuries ago, of such a contrivance was theoretically to dazzle or blind an enemy, metal disks being employed; but nearly all such devices failed to be of any practical value and fell into the category of "curiosities." The story of Archimedes will be remembered in this connection. Twenty years before Christ it is alleged he set fire to the enemy's ships by using an enormous sun glass. Sir William Herschel experimented with the sun's heat in Africa; and Captain Ericsson has made a number of studies in this direction and exhibited a solar motor in New York in 1884.

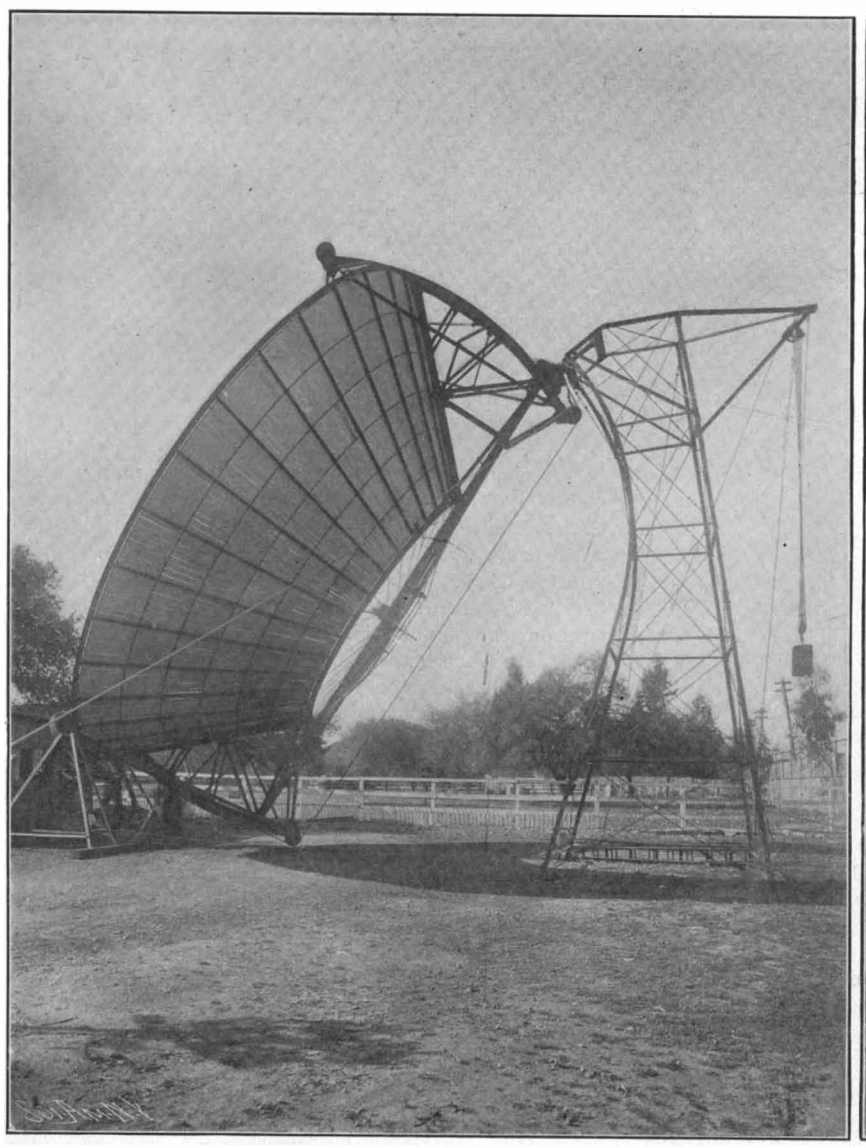
In Western America within the past twenty years it has been found that there are regions where it is especially desirable to obtain a motor which can be run practically without fuel. Such a region is the Californian desert, where vast mining interests have sprung up, and in arid sections where irrigation is necessary, and even in the richest portions of fertile California in connection with the question of irrigation. On the desert the sun shines almost continuously, and in Southern California the percentage of sunshine to cloud is remarkable. These conditions have called attention to the possibility of a practical sun motor, and it is interesting to note that in South Pasadena, California, such a machine has been set up and is successfully accomplishing the work for which it was made—an automatic engine running by the heat of the sun. This machine is exhibited at the Ostrich Farm, and has attracted the attention of a vast number of people, especially as Southern California is now thronged wtih tourists. In appearance the motor resembles a huge disk of glass, and at a distance might well be taken for a windmill of some kind; but the disk is a reflector thirty-three feet six inches in diameter on top, and fifteen feet on the bottom. The inner surface is made up of seventeen hundred and eighty-eight small mirrors, all arranged so that they concentrate the sun upon the central or focal point.



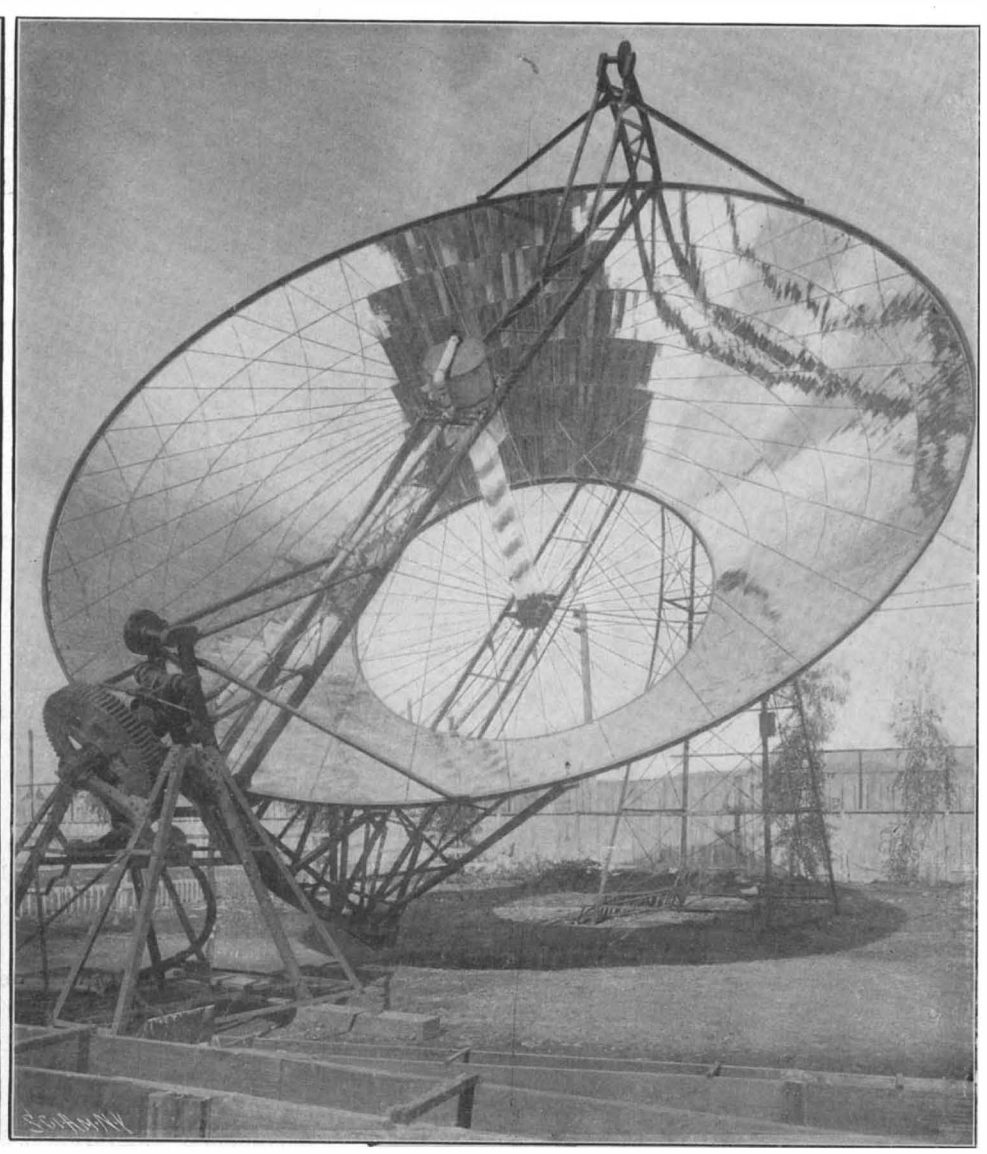
BOILER AND CONNECTIONS.

Here, as shown in the accompanying illustrations, is suspended the boiler, which is thirteen feet six inches in length, and holds one hundred gallons of water, leaving eight cubic feet for steam. At the time of the writer's visit to the farm the motor was the subject of no little comment, and the attendant stated, confidentially, that some of the questions asked were remarkable. One man assumed that it had something to do with the incubation of the ostrich eggs; and many asked what made it go, being unable to understand or appreciate the idea. The motor is attractive in appearance; built lightly, supported by seeming delicate shafts, though in reality strong enough to resist a wind pressure of one hundred miles an hour. The reflector must face the sun exactly, and as heavy as it is, weighing tons, it can be easily moved. It stands, after the fashion of the telescope, upon an equatorial mounting, the axis being north and south; the reflector follows the sun, regulated by a clock, the work being automatic, as, in fact, is everything about it. The true focus is shown by an indicator, and in about an hour after it is adjusted the boiler is seen to have attained a white heat and the steam gage registers one hundred and fifty pounds. The steam is carried from the suspended boiler to the engine in a flexible phosphor-bronze tube and returns again from the condenser to the boiler in the form of water, so that the boiler is kept automatically full. The engine is oiled automatically, and when the disk is once turned, facing the sun, it runs all day as independent of an engineer as does a windmill.

The amount of heat concentrated in the boiler by the seventeen hundred and odd mirrors cannot be realized, as nothing can be seen but a small cloud of escaping steam; but should a man climb upon the disk and cross it he would literally be burned to a crisp in a few seconds. Copper is melted in a short time here, and a pole of wood thrust into the magic circle flames up like a match. That the motor is a success is seen by the work it is doing—pumping water from a well, illustrating the possibilities of cheap irri-



SIDE VIEW, SHOWING THE FIXED SUPPORTS AND MOUNTING OF REFLECTOR.



FRONT VIEW, SHOWING THE SUN'S RAYS CONCENTRATED ON THE BOILER, AND GEARING FOR REVOLVING THE REFLECTOR.

A SOLAR MOTOR AT WORK AT LOS ANGELES, CAL.—15 HORSE POWER, STEAM AT 150 POUNDS PRESSURE.

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gation, and lifting fourteen hundred gallons per minute —equal to one hundred and fifty-five miner's inches. Up to the present time the motor has produced results equal to about ten horse power, but fifteen is claimed for it.

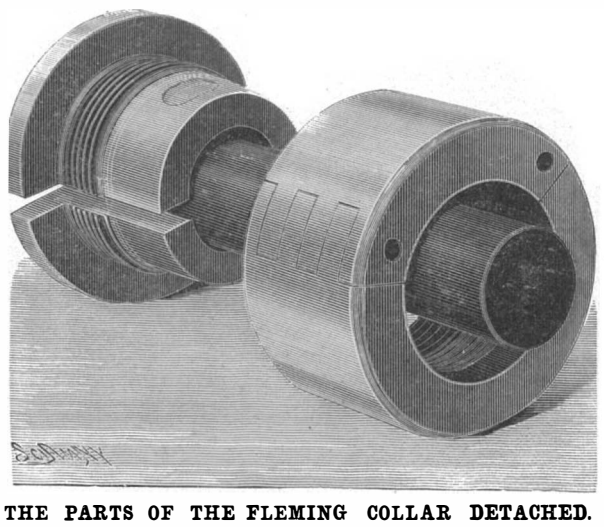
The motor is the result of a number of experiments by a band of Boston capitalists. One of the first productions was a silver reflector, which cost many thousands of dollars, but was abandoned. The next was modeled after the Ericsson machine of 1884; but it was a failure. A third was erected at Longwood, proving also a failure. A fourth attempt was made, this time in Denver, which was fairly successful, doing one-half the work of the Pasadena model. Finally the latter was produced and found to be a success. A duplicate, perhaps improved, will be erected at the Pan-American Exhibition. Dwellers in the East, where rain falls every few days throughout the year, cannot realize what such a perfected motor means to the West, where arid lands await but the flow of water to blossom as the rose. In such regions—and they represent millions of square miles—fuel is usually very scarce, often being so important a factor that the question of it determines the success or failure of the work. This is essentially true of the Californian desert and vast regions in Colorado, Utah, and surrounding States and Territories. Mines and pumping plants are often far from railroads, and in sections where no fuel is in sight, wood and coal being hauled from long distances. In such locations the solar motor is a boon. The skies are comparatively free of clouds, and the machine can begin work an hour after sunrise, possibly earlier, and continue until half an hour before sunset. It is possible that with cheaper methods of storing electricity sufficient power may be stored during the day to run the engine at night, or during the absence of the sun. Inventors are already experimenting upon methods of increasing the effectiveness of the motors, and probably larger ones, and groups of them, will be seen in the near future.

No invention of modern times has given such an impetus to the development of arid lands as the solar motor, and it has been visited by many interested in the question. The development of Lower California has been seriously impeded by the lack of fuel; the country being dry and barren in localities where rich mines are known to exist. The country is cloudless for months—in every sense the land for the solar motor, as water underlies the surface almost everywhere, and when pumped up and sent out upon the soil the region, which was formerly a desert, can be made fertile and literally to blossom as the rose.

THE FLEMING SAFETY COLLAR FOR SHAFTS.

Many of the accidents which occur in machine-shops and factories are due to the old-fashioned projecting set-screw by which collars are usually held on shafts. These set-screws have been condemned by factory inspectors, and even prohibited by law, for which reason they have often been countersunk, thus weakening the collar. Moreover, the collar is held in place only by bearing of the set-screw on the shaft. If the bearing-point slip, the collar moves from its place, thereby deranging the shafting and causing belts to slide from their pulleys.

These difficulties have been very simply and effectively overcome in the Fleming safety-collar, to which our attention has been called by Mr. W. H. Davis, P. O.

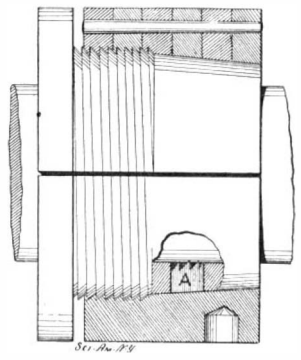


THE PARTS OF THE FLEMING COLLAR DETACHED.

Box 305, Montreal, Canada, and in which the set-screw is entirely abandoned. The Fleming collar comprises essentially four pieces — two symmetrical, tapering, threaded and flanged semi-cylinders, which embrace the shaft, a threaded locking-ring which binds the semi-cylinders firmly to the shaft, and a toothed gripping-key, *A*, received by an opening in one of the semi-cylinders and forced into engagement with the shaft by the locking-ring.

The merits of this arrangement are obvious. The set-screw is entirely dispensed with; the members can be taken from the shaft without removing any other part of the machinery; the collar is held to the shaft, not at one point alone, but through its entire length and internal circumference.

The fact that the collar can be applied to a shaft

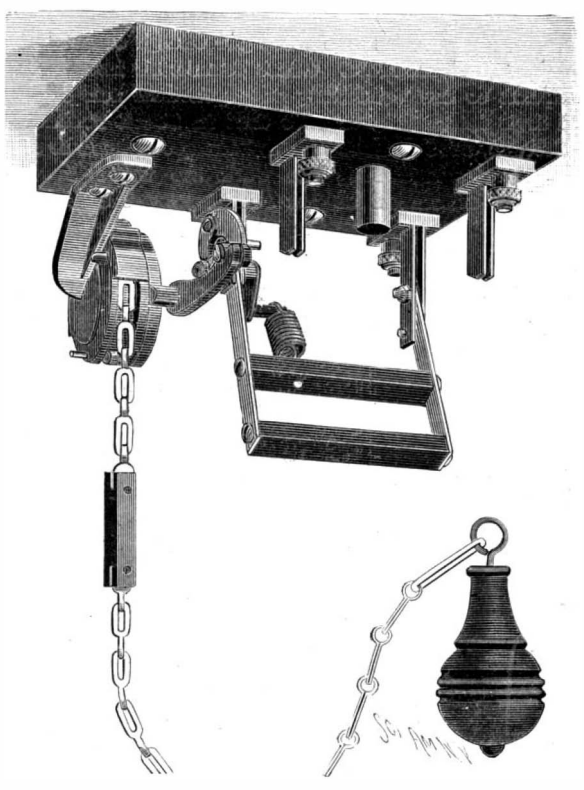


PARTIAL SECTION OF THE COLLAR.

without removing any machinery is in itself a significant feature. In all collars now used, the machinery on the end of the shaft must be taken off before the collar can be slipped on. The time, labor, and expense thus involved are items which are by no means small. Moreover, the cost of manufacture is no more than that of any collar now in use.

AN EFFICIENT SINGLE-PULL CEILING-SWITCH.

From the electrician's standpoint it cannot be denied that the ceiling-switch has merits which commend it to every consumer of electricity. It can be placed exactly where it is needed, and it dispenses with the wires which ordinarily run down to a suitable point on a wall. But these obvious merits have been more than offset by the mechanical defects which are unfortunately too often found in ceiling-switches. The two unsightly cords which form a part of most switches of this type cannot be manipulated with that ease which should be one of the distinguishing features of every electrical appliance. Our attention has been drawn to a novel switch made by J. Jones and Son, of



THE JONES SINGLE-PULL CEILING-SWITCH.

64 Cortlandt Street, Manhattan, New York city, which so far improves upon most ceiling-switches that the difficulties usually presented have been overcome.

The improved switch is a single-pull switch. By drawing downward on a single chain or cord, the circuit is opened or closed. Mechanically considered, the switch consists of a bed-plate screwed to the ceiling, which bed-plate carries the fixed contact-points and the switch-arms or blades, one of which is loosely pivoted and the other mounted on a rock-shaft. The rock-shaft carries a rock-arm and a crank, both of which have partial rotation in opposite directions. The crank is connected by a coiled spring with a cross-piece extending between the two switch-arms. The rock-arm is pivotally connected by means of a link with a crank-pin on a disk actuated by a spring-drum, to which a pull-chain is attached.

A pull upon the chain first winds the spring of the drum, then turns the disks and with it the crank-pin, through one-half a revolution As the crank-pin turns, the link is thrown forward, thereby swinging the rock-arm and the crank on the rock-shaft in opposite directions. As a result of this movement, the end of the rock-arm is made to engage an elbow-lever which assists in swinging the switch-arm out, and the crank is made to extend the spring by which it is connected with the cross-piece uniting the switch-arms. The switch-arms partially swung by the elbow-lever and by the strain on the coiled spring, are automatically carried entirely away from the contacts by the action of the extended coil-spring. This movement of breaking the circuit is effected with the utmost rapidity. When the pull-chain is released the drum is carried back by its spring without in any way disturbing the disk or the remaining parts.

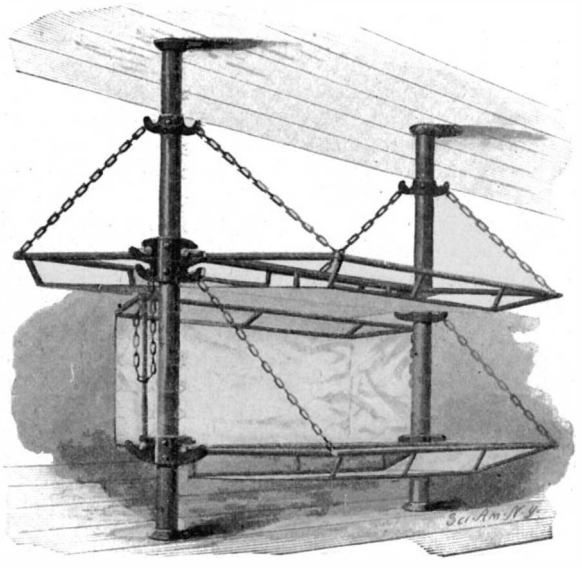
In order to close the circuit it is necessary merely to pull the chain again. The disk is then made to rotate through the remaining half of its revolution, thereby throwing the rock-arm and crank back to their initial positions, rocking the shaft, and extending the coiled spring. When the crank to which the coiled spring is secured passes the vertical the switch is automatically closed by the action of the extended spring. In both making and breaking the circuit the switch-arms are first partially swung and are then automatically actuated by the coiled spring.

A careful examination of the device convinces us that it is both quick and efficient in its operation.

A FOLDING BUNK FOR CARS AND SHIPS.

In emigrant or transport ships and cars it is often necessary to erect a large number of separate bunks, so arranged that they may be easily removed. A bunk of this type has been devised by John P. Lein, a New York inventor.

On two uprights or supports holders are carried having a slot with an upwardly-extended portion. Above the holders each of the supports carries hooks. The



A FOLDABLE AND REMOVABLE BUNK.

bunk itself is provided with contracted necks, which are received by the upwardly-extending slots. Chains attached to the outer side of the bunk are hung on the hooks to support the bunk.

In order to fit out a ship it is necessary merely to erect the uprights, insert the bunk-necks in the slots of the holders, and hook the chains in place. When not in use the bunk can be folded simply by turning it in the holders so that the link of each chain nearest the outer edge will engage the hook. The entire bunk can be readily removed whenever desired.

The Current Supplement.

The current Supplement, No. 1315, has many interesting articles. "The Evolution of the Adobe" is by C. F. Holder, and is accompanied by several illustrations. "Cameos" is by Cyril Davenport, F.S.A. "Optics of Trichromatic Photography" is continued. "Dock Equipment for the Rapid Handling of Coal and Ore on the Great American Lakes," by Arthur C. Johnston, is accompanied by many illustrations. Several articles in this issue are devoted to the consideration of modern commerce. "Women Astronomers" is by J. E. Gore. "Progress of Agriculture in the United States" is by George K. Holmes, and is a valuable article. "Britain's Leaning Towers" describes two curious examples. The recent Berliner patent decision is carefully digested. "Excavations at Carthage" describes some important discoveries. "Constellation Figures as Creek Coins" is by Robert Brown, Jr., and is a curious study in numismatics.

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RECENTLY PATENTED INVENTIONS.

Electrical Apparatus.

ELECTRIC-ARC LAMP.—PETER H. F. SPIES, Mount Vernon, N. Y. The carbon in this arc-lamp is engaged by a feed-clutch, the action of which is controlled by a special mechanism. The lower carbon is inclosed by a globe. A gas-check plate is provided, together with means for regulating the arc and accommodating the lamp to the voltage across the arc, these means being adjustable to lengthen or shorten the operative path of the feed-clutch by increasing or decreasing the distance between the feed-clutch and the gas-check. When the clutch is released the upper carbon moves down gradually, without shock. The form of gas-check employed serves to increase the light of the carbon; for, the air entering the globe through the check, passes successively through several chambers and is heated before reaching the interior of the globe.

ELECTRIC SWITCH.—PETER H. F. SPIES, Mount Vernon, N. Y. This electric switch for arc-lamps and switchboards is arranged to make and break the circuit positively. By means of the switch a lamp can be readily lowered to renew the electrodes without the slightest danger to the operator and without throwing other lamps in the series out of circuit. The switch comprises a receiving socket, a contact plunger for engagement with the socket, a series circuit, a local or loop circuit, and a cut-in device so arranged that when the plunger and socket move out of engagement, and the local circuit is broken, then the cut-in device maintains the series circuit unbroken or closed. The circuits have flexible and compressible contacts, each composed of a number of interlocked helices.

Engineering Improvements.

LUBRICATOR.—CHARLES SLATER, Portland, Me. Mr. Slater's lubricator is designed to keep the lubricant used for steam-chest valves, pistons, and the like, in a warm or flowing condition, to insure a thorough lubrication of the parts at all times. The lubricator consists of an oil-cup surrounded by a jacket. Between the cup and jacket is a hot-air space. A steam-pipe extends through the jacket. At the upper portion of the steam-pipe is a pressure-operated valve. The steam-pipe communicates with a condenser, from which a pipe leads into the oil-cup. The oil passes from the cup to the steam-pipe through a tube. The steam condensed in the condensing-cylinder flows into the lower portion of the oil-cup, thus displacing a certain quantity of oil. This displaced oil passes to the parts to be lubricated.

ROTARY ENGINE.—CARL C. JENSEN, 15 Haregade, Copenhagen, Denmark. The present invention refers to improvements in rotary engines, by means of which the period of admission or cut-off and the period of expansion can be easily regulated and the direction of the motion readily reversed. These results are obtained by means of a main slide-valve, arranged adjustably on the rotary shaft, in combination with an expansion slide-valve placed between the main slide-valve and the shaft, and with steam-passages extending through the rotary shaft itself.

Mechanical Devices.

ORE-CONCENTRATOR.—CHRISTOFFER A. CHRISTENSEN, Sixth and Morrison Streets, Portland, Ore. As the crushed ore is fed from a suitable hopper to the feed-end of a concentrating pan, power is applied to a pulley carried on an eccentric shaft connected with the pan. Thereby the pan is vibrated from side to side, and the ore gradually works its way down. All the heavy and valuable particles are shaken to the bottom of riffles, and find their way through perforations in front of and at the bottom of each riffle. Then the concentrate falls upon a laterally-inclined washer-plate and is washed down by means of a spray-pipe.

WINDMILL.—JOHN R. E. BYRNE, Tilden, Tex. The invention is an improvement for supporting the wheel and operating shafts. Novel features are to be found in the means for throwing the controlling devices into and out of engagement with the wheel, and in the general construction of the wheel itself. The most important feature, however, is an all-lever shut-off, which is not affected by any ordinary wear, and the weight which adjusts the brake clear of the wheel can be conveniently regulated to any extent. This weight also holds the wheel at right angles to the vane.

SELF-PLAYING STRINGED MUSICAL INSTRUMENT.—FRIEDRICH SCHNEIDER, Leipsic, Saxony, Germany. The inventor has devised a mechanically-actuated stringed musical instrument which is strong and simple in construction, and which requires but little power to drive the note-sheet uniformly. This note-sheet operates the device for picking the strings, and the device for fingering the strings so as to produce the desired music with comparatively few strings stretched over a sounding board.

BOTTLE-FINISHING MACHINE.—WILLIAM P. PARSONS, Albany, Ind. The patent describes a machine by means of which the interior and exterior of glass bottle-necks are simultaneously and quickly finished. The bottle to be finished is held in a frame, the handle of which is supported on grooved rollers arranged in standards. The neck of the bottle is placed over an interior-finishing device. By means of a treadle a check or sleeve is shifted forward to move exterior-finishing devices into close contact with the bottle-neck. The pressure is regulated by the pressure on the foot-treadle. In order to finish the bottle the shafts by which the finishing devices are rapidly rotated, one independently of the other.

BELLOWS FOR ROCKING-CHAIRS.—CHRISTIAN U. KRIEG, SR., Nashville, Tenn. Beneath the rocking-chair a pair of bellows is secured, having an inlet operated by the chair, and outlet valve-chambers, connected by a tube. A valve in this tube controls the passage of air from one to the other of the outlet-chambers. The bellows has a lower box, adapted to receive an ice-receptacle, by means of which the air can be cooled. The back and forward motion of the chair, while being rocked, supplies cooled air. But this motion renders bellows of the ordinary construction having stiffened sides useless for the inventor's purpose. A bellows of peculiar construction has therefore been invented to meet the special requirements of the case.

Miscellaneous Inventions.

HITCHING DEVICE.—NOAH L. DALLARD, Wheeling, W. Va. The hitching device comprises, essentially, a pair of tongs, which are closed by drawing the handles together. These handles are connected by a chain with the horse's bridle. Hence, the device can be applied to any suitable projection in order to hold the horse; for, a pull upon the handles merely forces the tongs further into the object gripped. A coiled spring holds the tong members together, so that when the chain is slack the device will not fall to the ground.

SCRUBBING-BRUSH HOLDER.—JOHN L. DONNELLY and JOHN S. BRADY, Wilkes-Barre, Pa. The scrubbing-brush holder has a reservoir provided with a perforated bottom through which water may pass to the brush. The reservoir is replenished through a top filling-hole having a sliding cover. The brush can be readily removed from the holder and another inserted.

HEATER OR COOLER FOR LIQUIDS.—GABRIEL J. L. HENRY, Quebec, Quebec, Canada. The heater or cooler comprises a tank, above which a receptacle is located having an opening leading to the tank. Within the receptacle is a rotatable cylinder, secured to the upper portion, on the inside of which are buckets or vanes. Against these buckets the liquid is discharged. To the outer surface of the cylinder a liquid is fed of a temperature different from that of the jets discharged from the buckets. The rotation of the cylinder is advantageous for the reason that it spreads the liquids on the cylinder-surface so as to secure a large heating or cooling area.

MULTIPLYING PHOTOGRAPHIC CAMERA.—JACOB F. STANDIFORD, Fort Scott, Kans. Mr. Standiford has devised a multiplying photographic camera by means of which a number of exposures can be made upon a single plate. The construction of the camera is such that upon moving the ground glass into or out of focusing position the shutter is automatically opened and closed without requiring the re-insertion of the slide and without danger of exposing the plate to the action of light during the movement of the ground glass.

TIRE-CEMENT.—JOHN H. BENNETT and ALONZO F. BEMAN, Ridgway, Pa. The tire-cement rapidly repairs any leak or injury in pneumatic tires used upon bicycles, carriages, automobiles or other conveyances. The ingredients of the cement are wheat-flour, lamp-black, potassium permanganate, together with a suitable quantity of water, the whole forming a paste of unusual adhesive qualities.

CEILING STRUCTURE.—BALTHASAR MAIBACH, Manhattan, New York city. This fireproof ceiling structure consists of a girder formed of opposite members of metal. Each member consists of a lower, straight bar-like section, an upper section and a downwardly arched intermediate portion, a brace-member secured in the arched portion, and tie-rods connecting the opposite members. After placing the girder members in position, a filling of cement is employed to strengthen the construction.

DEVICE FOR TREATING DISEASES OF THE EAR.—MIKE POLICH, Riverside, Cal. The invention provides a means for treating diseases of the ear, the means comprising a sheet of fabric rolled into tubular form. This fabric bears certain medicaments, so that when the fabric is ignited the medicaments will be applied to the diseased parts.

SHIP'S COMPASS.—HINRICH BRUNS, Bremen, Germany. Compasses in general use do not enable the helmsman to follow a course between two divisions on the compass card. In such cases the helmsman must rely upon his eye and his good judgment for the measurement of a fractional part of a marked division. The present invention enables the helmsman to follow a true course without tiring his eye. An adjustable plate is provided on the compass-plating, which plate has an auxiliary steering-line or point adjustable to the right or to the left of the fixed steering-line or point. This adjustable line can be used instead of a fixed line whenever the course is such that it cannot be read exactly on the compass card.

GARMENT-HANGER.—LOUIS YONTEFF, Manhattan, New York city. This garment-hanger is a simple, durably-constructed device for supporting trousers, coats, vests, skirts, and wearing apparel in general. The hanger is easily extended, hung up or readily folded into a comparatively small space.

FLOWER-HOLDER.—SIMON WEILER, Manhattan, New York city. The object of the invention is to provide a flower-holder that can be attached to any part of the dress to hold a bunch of flowers in any desired position. The holder comprises a bar having a fastening device by which it is secured to the dress. A pin on the bar extends approximately parallel to and in the direction of the length of the bar to receive the stems of a bunch of flowers. Ribbons on the bar can be passed in front of the stems and tied in a bow.

Designs.

HOLDER FOR NECKTIE-BANDS.—ZALAL GUZIK, Manhattan, New York city. The holder consists of a back-plate terminating in a needle and a sheath in front of the plate.

MANTEL.—CLAY B. ATKIN, Knoxville, Tenn. Two design patents have been issued for mantels. In the first the lower portion of the mantel has a shelf provided with an ovolo molding and beaded fillet, below which is a horizontal panel provided with a central ornamentation consisting of a floral harp-shaped figure and two diverging, lateral, floral portions. The upper portion of the mantel has a fixed central piece provided with a partly floral and partly arabesque ornamentation. Below this is a shelf and side-panels having ornamental floral figures. Two vertical columns flank the central panel.

In the second design the lower portion of the mantel has an ornamented shelf, as in the previous case, and the panel below it has a double ornamentation in relief, which simulates the fleur-de-lis; also horizontal ribs, above and below. The upper portion of the mantel has a top edge, with curved ends, provided with floral decorations at center and sides. A shelf having a beaded fillet and ovolo molding is arranged below, and beneath this is a panel or mirror, and on the sides of the same is a curved or S-shaped floral relief. Two columns are arranged as in the previous case.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

THE ELECTRO-MAGNET. By Townsend Wolcott, A. E. Kennelly and Richard Varley. Jersey City, N. J.: The Varley Duplex Magnet Company. Pp. 130. Price $1.

This little book, a second edition of which has recently been issued, is excellent for obtaining a thorough knowledge of the theory and practice of the electro-magnet. It is well illustrated, and contains a number of tables giving the electrical properties of copper magnet wire. Numerous mathematical formulæ are given and their application illustrated by the use of practical examples. A set of logarithmic tables is appended, together with a scale, by means of which, in connection with the tables, any root or power of any number can immediately be found.

HOW TO BUILD A SKIP-JACK. Reprinted from the Rudder. New York and London: The Rudder Publishing Company. 1901. Pp. 38, 24 plates and engravings. Price $1.

HOW TO BUILD A RACER FOR $50. Reprinted from the Rudder. New York and London: The Rudder Publishing Company. 1901. Pp. 52, 36 plates and engravings. Price $1.

These two excellent little volumes will be welcomed by the amateur yachtsman whose purse or inclinations tie him down to miniature craft. The racer is that curiosity of yachting architecture known popularly as the "Lark," which, while not a perfect craft, is justly considered as being, for "what she costs in labor and money, the best thing that ever carried sail."

The skip-jack is a compromise between the flat and round bottom craft, which has the two-fold qualities of being easy to build and speedy to sail. Both of these works are written in the clear style characteristic of The Rudder, and they are so amply illustrated that he must be a poor carpenter who cannot, with the aid of proper tools and material, put one of these boats together.

SCHERZER ROLLING LIFT BRIDGES. Second revised and enlarged edition. By Albert H. Scherzer. Chicago, Ill.: The Scherzer Rolling Lift Bridge Company. 1901. Oblong quarto. Text 68 pp., with numerous line drawings and 23 plates. Price $10.

This handsome work opens with a short chapter on the history of pivoted or trunnion bascule bridges. After a reference to the Tower Bridge, London, and other developments of the pivot or trunnion bascule bridge, it enters into a general argument of the disadvantages of the swinging bridge and other high and low level methods of crossing navigable rivers and streams, and then passes on to a detailed description of the Scherzer rolling lift bridge, views being shown of the various existing structures which have been built on this well-known system. This handsome work is elaborately illustrated by numerous diagrams and line drawings and by twenty-three full-page photogravure plates.

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READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send your name and address to the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 145.—For manufacturers of special seamless, brass tubing.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 146.—For a description of the Bogardus mill, used in graphite works at Ticonderoga, N. Y.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 147.—For machinery for manufacturing matches,

Yankee Notions. Waterbury Button Co., Waterb'y, Ct.

Inquiry No. 148.—For acetylene gas plants suitable for houses, churches, and schools.

Metal Novelties Manuf'd. Bliss-Chester Co., Prov., R. I.

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Finest quality Steam Engines, Boilers and Burners for Automobiles. Write Rochester Cycle Mfg. Co., Rochester, N. Y.

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Guns and Sporting Goods. Keating Wheels. New catalogue out now. The H. & D. Folsom Arms Co., 314 Broadway, New York.

Inquiry No. 151.—For pinless clotheslines.

Ten days' trial given on Daus' Tip Top Duplicator. Felix Daus Duplicator Co., 5 Hanover St., N. Y. city.

Inquiry No. 152.—For machinery for weaving wire mattresses,

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 153.—For fire engines and appliances suitable for fighting fire in small towns.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 154.—For manufacturers of water meters.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $4. Munn & Co., publishers, 361 Broadway, N. Y.

Inquiry No. 155.—For sanitary household furnishings.

Wanted—Revolutionary Documents, Autograph Letters, Journals, Prints, Washington Portraits, Early American Illustrated Magazines. Correspondence Solicited. Address C. A. M., Box 773, New York.

Inquiry No. 156.—For the smallest sized dynamos and motors.

Machine Work of every description. Jobbing and repairing. The Garvin Machine Co., 141 Varick St., N. Y.

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Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 159.—For the manufacturer of artographs.

Inquiry No. 160.—For the address of the Columbia Carbide Company, in New York city, or similar concerns.

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Inquiry No. 162.—For manufacturers of small wooden hardwood boxes, 2 by 4 up to 4 by 4 inches.

Inquiry No. 163.—For filtering apparatus that will filter a starchy liquid rapidly.

Inquiry No. 164.—For builders of gasoline motors for automobiles.

Inquiry No. 165.—For the address of the manufacturers of the "Lambert" gas and gasoline engines.

Inquiry No. 166.—For small gasoline or other motors suitable for experimental purposes.

Inquiry No. 167.—For manufacturers of agricultural machinery.

Inquiry No. 168.—For parties willing to undertake the manufacture of a steel novelty in three thicknesses, 1¼ by ⅝ inches.

Inquiry No. 169.—For tinners' machinery.

Inquiry No. 170.—For boiler makers' machinery.

Inquiry No. 171.—For ornamental woodwork for furniture, made by pressing the figures on the wood.

Inquiry No. 172.—For fine needles or pins for lace-curtain frames.

Inquiry No. 173.—For machinery for manufacturing buckets, pails, etc.

Inquiry No. 174.—For machinery for making wood toothpicks.

Inquiry No. 175.—For manufacturers of a mill or process for extracting potash from cottonseed meal hulls.

Inquiry No. 176.—For tools for the removal and replacing of boiler tubes, also boiler flue cutters, expanders and beaders

Inquiry No. 177.—For parties willing to manufacture a new computing scale.

Inquiry No. 178.—For manufacturers of solder for fastening aluminium to aluminium or copper to aluminium.

Inquiry No. 179.—For manufacturers of small ice machines suitable for home use.

Inquiry No. 180.—For the distributers of the "Arlington" rubber collars and cuffs.

Inquiry No. 181.—For parties who can make soft wood shoe knife handles, enameled brown and in imitation of walnut.

Inquiry No. 182.—For automatic grinding machines for grinding butchers' knives.

Inquiry No. 183.—For rubber prepared for vulcanizing, about the thickness of a lead pencil.

Inquiry No. 184.—For heavy cardboard disks, about 11 inches in diameter.

Inquiry No. 185.—For "Harry's" electrical retouching device, for retouching photographic negatives.

Inquiry No. 186.—For manufacturers of liquid fire extinguishers and hand grenades.

Inquiry No. 187.—For canning machinery.

Inquiry No. 188.—For condensed milk machinery.

Inquiry No. 189.—For machinery for making binder twine.

Inquiry No. 190.—For Portland cement machinery.

Inquiry No. 191.—For automatic numbering machines.

Inquiry No. 192.—For rubber type daters.

Inquiry No. 193.—For Britannia metal and sterling silver blanks ready for spinning.

Inquiry No. 194.—For spinning lathes.

Inquiry No. 195.—For the address of Chas. Platt, silver roller.

Inquiry No. 196.—For glass novelties, such as peppers and salts for ornamenting with silver.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(8098) L. J. J. writes: 1. I have a small fan motor of 52 volts, ⅛ horse power, alternating current, which I run on direct light current, 52 volts. It has a great deal of power, but sparks a great deal. Could you advise me in the next issue of your valuable paper how to prevent this? A. Your alternating-current motor, when put on a direct current, gets more current than it could get from an alternating circuit. It therefore runs faster and sparks more than it should. The brushes are perhaps not in the proper position. Slide them to and fro around the commutator, and find the position of least sparking. If this does not cure the trouble, you can add a resistance to the external circuit, so as to cut down the current which enters the motor. 2. Why will it not generate when run by an 18-inch fly-wheel? It goes very fast. A. Many of the small motors cannot excite their own fields and build them up. They cannot, for that reason, be run as generators. 3. Should telephone be grounded on house or earth side of gas meter, and why? A. It is better not to ground anything to a gas-pipe, either side of the meter. A flash of lightning or a lightning wire falling across the telephone wire might produce a spark which would set fire to the gas and to the house. Perhaps the earth side of the meter is a little better ground than the house side.

(8099) F. T. asks: 1. Can water be decomposed and the gases collected separately by an alternating electric current? A. No; the gases will be mixed at each pole in the same proportions as they are in water—hydrogen 2 parts, and oxygen 1 part. 2. What chemicals are most frequently used in a dry battery? A. Dry cells are usually modified Leclanche cells. The sal ammoniac solution is held in some absorbent material, so that it will not run out of the cell when it is upset. 3. In the preface of Tesla's "Experiments with Alternating Currents of High Potential and High Frequency" it mentions a thermo-magnetic motor he devised. What was the principle of it? A. A thermo-magnetic motor, or, as it is usually called, a pyro-magnetic motor, consists of an armature formed of a disk or ring of thin steel, which is set in motion when unequally heated by reason of the difference of force so produced. Mr. Edison invented a pyro-magnetic generator which acted on the fact that iron ceases to be magnetic at about 770 deg. C., and converted the heat energy by means of it into electric energy. He used a thin iron tube in a strong magnetic field surrounded by a coil of wire. By varying the temperature of the tube near 770 deg. he varied the magnetism passing through the coil, and thus produced a current in the coil. 4. Can a storage battery be charged by an alternating electric current? A. No. 5. What is a thermostat? A. An instrument which closes or opens an electric circuit when heated or cooled.

(8100) J. M. A. asks: 1. A condenser, i. e., a double-convex lens, will throw a focus of ½ inch in diameter, which gives a heat of 500 deg F.; what will another condenser of twice the diameter, but of the same focus, give in heat? A. The area of the larger lens is a circle of twice the diameter and four times the area of the smaller. It will allow four times as much light and heat to pass through it. 2. Is the intensity of the heat as the square of the diameter? A. The quantity of heat is proportional to the square of the diameter of a lens through which it is transmitted. The intensity of heat in a focus is approximately so also. Whether a piece of metal, such as a mercury thermometer or a piece of copper, will be heated to a higher temperature, and how much higher, depends upon the specific heat of the metal and upon its condition as regards radiation. It is difficult, if not quite impossible, to determine to what degree of a thermometer a given quantity of heat will raise a piece of a given metal. 3. Will the same rules hold good for a parabolic reflector as for a condenser? A. No; a parabolic reflector sends the rays out in a parallel beam when the source of heat or light is placed in its focus. The intensity does not then diminish as the square of the distance. 4. Is there any book published on the collecting and applying heat from the sun's rays and on the storage of such heat? A. Langley's "New Astronomy," price $3 by mail, contains a chapter on this subject. It shows pictures of the several solar engines which have been used at various times in the effort to find a mode of utilizing the great heat of the sun. We have published several articles in the Supplement on the subject of solar energy; No. 13, by John Ericsson, who devised a solar engine; Nos. 212, 214, 216, 217, 218, by Prof. Langley; price ten cents each.

(8101) J. E. H. writes: If a machine at a revolution of say 2,100 gives an electric current of 3 amperes at 10 volts, what is the most practical way to get a current of ½ to 1 ampere at 10 volts from it? If through coils and a reduction of speed, please give size of wire used and number of turns for each spool. A. The current a machine gives depends on the resistance of the external circuit. If you have three amperes through a certain circuit, to have one-half as much double the resistance of the external circuit. With 10 volts, the current will be 3 amperes when the resistance is 3 1-3 ohms. For one ampere the resistance must be 10 ohms. Now, if you have a part of the 10 ohms in the apparatus used, you will only require the rest of the resistance in a coil. No. 24 German-silver wire has a resistance of one ohm to three feet. From this you can calculate what you need.

(8102) O. M. S. asks: 1. I want to put up a telephone between my place and a neighbor's about a half a mile distant. I have two receivers, dry and bichromate batteries. Now, can I put up a telephone by connecting the receivers and battery, one at each end, to a barb-wire fence, in which the wire is fastened uninsulated to the post by staples, and use common electric alarm bells? A. Yes; if the wire is continuous, without breaks or loose joints. It must be spliced as strong as a telegraph wire. Such an arrangement will work only when the fence is dry. 2. If this can be done, please tell me how to connect the batteries and receivers to the fence. A. Connect the batteries and receiver to the line in series. Put half of the battery at each end of the line, using care that the poles at each end are in the same order. 3. How much power will be needed? A. We cannot tell. A great deal more than with an insulated line. 4. Can dry batteries, when the current gives out, be restored? If so, how? A. No; they can be opened and filled with sal ammoniac solution, running them as wet cells till the zincs are used up. 5. How can you magnetize a piece of iron by using a magnet? A. A piece of iron cannot be permanently magnetized. It is made into a magnet by bringing one end to the end of the permanent magnet.

(8103) J. M. S. asks: 1. In making an electric furnace, there is a core of fire-clay wound with platinum wire and then covered with clay and asbestos and connected up with a rheostat. Is there anything but platinum wire used, or do they cut in a fiber similar to that used in an incandescent lamp? A. You seem to be describing an electrical heater, and not an electrical furnace. The electrical furnace is made by bringing two carbons into contact and then drawing them apart while they are covered by the substance to be treated in the furnace. A very high temperature, which will melt any substance, is thus produced. A platinum wire wound on fire-clay can hardly come under the designation of an electrical furnace. In such a heater as you describe there would be no advantage in using a carbon filament. 2. In making a controller to reduce electric current (107 volts, alternating), what size of German-silver wire is used, and how long should each space be to the branches, so as to reduce same to 2 volts, 3 volts, 4 volts, 5 volts, 6 volts, 7 volts, 8 volts, and 9 volts? A. What you want is not a "controller," but either a transformer or a choking coil. A controller is used with a direct current. A choking coil can be arranged with branches so as to give the various drops in voltage which you mention. We cannot give you a design for this, as we know nothing about your current, except the voltage, nor what you wish to do. Apply to the company furnishing the current for the apparatus. 3. Could I use the insulated German-silver wire, and splice in short pieces the required distance, and then wind same up in a ball, leaving the various ends protrude, connect each up with a button, and use switch leaves, with button, that correspond to the voltage desired, without danger of burning same out? Am using 107-volt, 1,200-ampere, alternating current. A. No; a rheostat becomes heated by the current which flows through it. This would burn the insulation. Wound into a close coil, the wire would be still more heated than if wound into a spiral. Resistance coils are wound into open spirals, and placed so that air can draw through them and keep them cool.

(8104) F. J. S. writes: To have a current we need two different substances united by two contacts—one liquid, one metallic. Such a case occurs in an ordinary zinc cell when a particle of iron is embedded in the zinc surface. This wasteful circuit is done away with by amalgamating. But does not this evil effect (local action) necessarily exist in the storage battery? There is the metal grid in immediate contact with the oxide, and at the same time in contact with it through the intermediary of the liquid. Thus it would appear that there ought to be a vast amount of local action all the time. A. There is no local action in a storage cell. The only action on open circuit is the slight formation of lead sulphate by the combination of the lead and sulphuric acid. This is a very slow process. The action of a storage cell is between the peroxide of lead and the spongy lead on the negative plate.

(8105) L. A. G. asks: 1. In the telephone-magneto generator described in Supplement, No. 966, could the steel magnets be charged by simply placing them against one of the poles of the magnet of a powerful dynamo, or would consequent poles result? A. Permanent magnets are best magnetized by a coil of wire through which a current of electricity is flowing. Pass the magnet steadily through the coil back and forth. 2. When constructed as directed in the Supplement, through what distance will the generators ring? That is to say, how many thousand ohms will the generator be? A. We do not know. 3. Could you also give me a good formula for a red and a black pigment or enamel for painting the generator magnets with? A. Any good varnish paints will do. 4. In the Hunning's telephone transmitter described on page 813 of "Experimental Science" (next to last edition), how fine and how hard packed should the granular carbon be? Would a carbon diaphragm and carbon back give better results than a brass back and ferrotype diaphragm? A. The carbon grains of proper form and size can be purchased of manufacturers of telephones, for which see our advertising columns. The packing should be adjusted to clearest transmission by experiment. 5. Can the small alternating dynamo described in the Scientific American, Vol. 77, No. 11, be made self-exciting and still give 110 volts? How? A. No; there is not room on the armature for a commutator. You can redesign the yoke, etc., and put in a direct-current arrangement. 6. Would you furnish me with a list of the articles that have been published in the Scientific American (not the Supplement) on the telephone and the dynamo? A. Many details of the telephone are described and illustrated in Supplement, Nos. 142, 163 and 966. Illustrated articles, giving complete details for the construction of small dynamos, are contained in Supplement, Nos. 161, 599, 600, 844 and 865. We supply the Supplement copies at ten cents each. For a list of many general articles on these subjects, we refer you to pages 13 and 17 of the Supplement Catalogue, which we supply free on application.

(8106) F. M. writes: Some two or three weeks ago, in Notes and Queries, you said water was a non-conductor, since which time I have got into all kinds of trouble by making this claim. Please explain how a fireman in Kansas City was knocked over the other day when the stream from the metal nozzle came in contact with a live wire. Also the old trick of trying to get a piece of money out of a bowl of water connected to a battery; why wetting the hands before taking hold of an electro battery will intensify the shock. A. We regret that you have been brought into trouble by inability to defend our statement that water is a non-conductor of electricity. Yet such is the fact, without any qualification. But the water must be pure, of course. Any impurity immediately lowers the resistance of the water very greatly. All the cases you cite are of this character. A man's hands are not ordinarily clean, never chemically clean. Should they be made so and dried, the first traces of perspiration would bring with it salt, and this is a good conductor. Dry hands are very well insulated by the skin. We never heard of any difficulty in taking a coin from a bowl of water connected to a battery. If the bowl were connected to a charged Leyden jar, there would be a shock on touching the water—ordinary water. Thompson, in his "Elementary Lessons in Electricity," gives the resistance of pure water as 265,500,000,000, when the resistance of copper is 1.57. Now, divide the large number by 1.57, and you will have the fact that pure water has 1,777,777,777, or, roughly, one billion and three-quarters times as much resistance as copper. Glass has only about 1,000 times the resistance of water, and glass is one of our best insulators. Now, add 5 per cent of sulphuric acid to the purest water and its resistance drops 500 times. A water resistance is a very common thing in electrical works nowadays. We hope these facts may enable you to discomfit your adversaries.

(8107) R. D. T. writes: I have made one of the motors described in Scientific American of December 8 and 15, 1900, and mounted same temporarily on wood bearings. Have tried three cells of open circuit battery in series (and multiple arc), but can get no effect whatever. Field is not short-circuited. A few questions. 1. Ought there not to be some effect with two or three cells when motor is mounted as above? A. Yes. There ought to be plenty of magnetism in the field and a spark at the terminals on breaking the circuit. 2. How can I test the armature and windings, not having a galvanometer? A. Connect one end of the winding to the battery, and try with a wire from the other pole of the battery whether a spark can be obtained from the iron of the armature core, or the yoke of the machine. This will show if the winding is grounded on the machine. 3. Would introducing a compass in place of armature and brushes demagnetize the compass when current as above is turned on? A. No; it would make the compass stronger. 4. Why should armature revolve by hand as easily one way as another when field is not short-circuited, with three cells of wet battery like Leclanche open circuit? A. Probably because there is no current flowing. It seems as if you have no circuit through the motor. Perhaps you have connected up the field magnet so that the two halves neutralize each other. 5. Where can I get the brass balls necessary? A. You cannot purchase solid brass balls. We think you will have to make them.

(8108) L. A. D. writes: I have trouble with my photo plates in the fixing bath, which takes off the black and leaves the plate gray. Fixing bath used is 1 ounce hypo. to 3 ounces of water. I wish you would help me out. I develop the plates a good black in the high lights, but after fixing they are gray, with no contrast. Please give me a receipt for a fixing bath which will not destroy the high lights. A. The trouble with your photo plate does not, probably, lie with the fixing bath. This does not take away the black and leave them gray. They were thin before they went into the hypo. The trouble is over-exposure or under-development. The best formula for any plate is the one given by the maker in the box of plates. You cannot improve on that. Expose a shorter time and find by experiment what the proper time is for exposure.

(8109) J. M. S. asks: 1. How are electric furnaces (for dental uses, fusing porcelain, alternating current) wound? I am informed that platinum wire is used, but is that all? Is not there something similar to the fine film or carbon used in incandescent bulbs connected in to avoid burning out a fuse? A. The heating furnaces which have recently come into use are of platinum wire, wound on a non-conducting core. The resistance is made such that the proper current flows without fusing the platinum, and no external resistance is employed. The limit of temperature is the melting point of platinum. 2. Would there be very much expense in changing a motor from alternating to direct? A. A commutator is required in place of the collector rings. Its cost depends on the number of bars required in it. 3. Is it possible to charge a storage battery from an alternating current? A. No; except the alternating current is used to run a rotary converter. 4. There is an electric appliance out for annealing gold foil, used by dentists. Can you tell me how it is made? A. We have no information about this heater.

(8110) T. D. asks: What is the voltage of the Edison-Lalande battery, type "W?" A. The manufacturers, in their catalogue, give 0.667 volt as the mean working E. M. F. of a cell.

(8111) W. O. E. asks: Please tell an old reader of the Scientific American what is the specific heat of hydrogen gas at constant pressure and constant volume. A. The mean specific heat of hydrogen at constant pressure is 3.4062, on the authority of Regnault and Wiedermann. The calculated specific heat at constant volume is 0.2419, by some authorities; by others it is given as 0.2359.

(8112) C. & Son write: We desire to melt a small amount of iron for experimental purposes, not sufficient to pay for a cupola. Can you give us any information on the subject? A. You can melt 3 or 4 pounds of cast iron in a black lead crucible in a forge fire by building up a loose brick furnace around the tuyere, with about 3 inches clearance around the crucible.

(8113) G. E. C. writes: Am thinking of making the mercurial barometer described in Scientific American, February 2, 1901, page 74. Would like to know how many ounces of mercury I should get, and what it will cost. A. Not more than a half pound is actually required, but a pound will make the work easier.

(8114) J. B. Co. asks: In your issue of December 1 you describe and illustrate artificial lightning. Will you put us in the way of getting specific information as to the amount of current necessary to operate one of these signs? Our commercial current is 500 volts, 104 and 110 volts. A. We do not know any way in which so strong an effect can be produced directly by 500 volts of pressure. Ten times as much pressure is desirable. It can be obtained by a powerful transformer.

(8115) R. D. asks: Will you kindly give me a description of the secondary section windings of induction coil, such as Rietchie, in Boston, uses for his coils, or is there a book written on this subject which gives full information regarding such windings and sizes of wires used? A. The making of a modern induction coil, with the secondary in sections, is fully described in Supplement No. 1124, price ten cents. The dimensions of all parts and sizes of wires are plainly given.

(8116) E. P. R. writes: In testing the small disks as they are wound (in making a Ruhmkorff coil) I use the galvanometer and battery of sufficient strength to deflect the needle, to tell whether the wire is broken or not in winding. I have the battery and meter connected up and have two clamps to attach to the terminals of the coils when testing. I noticed that at times the needle would deflect one way and then the next time it would deflect just the opposite to what it did before: and as I knew that the current was passing through the meter in the same direction at all times, I made an investigation and found that if I connected the outside terminal of

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the disk to the wire from the battery and the inside terminal to the wire from the meter that the needle would deflect one way, and by connecting them just the opposite the needle was deflected just the opposite as to what it did before, just the same as it would had I changed the direction of the current through the meter, which I did not do. I made several tests, with the same result each time. I have never heard of anything like it before, and do not know whether I am in the wrong or not about the matter, but can see no reason for the needle to change. Will you kindly explain, if it is worth an explanation? A. In the second mode of connecting the coil to the battery and galvanometer the current flows through the coil in the opposite direction from which it flowed the first time. The poles of the coil are therefore reversed. It may be that the coil is so near to the galvanometer that its needle is deflected by the coil. We do not see any other way in which the deflection of the needle should be reversed.

(8117) G. G. A. E. asks: 1. How can you determine the size of wire to be used in different circuits? Is it according to the capacity of the wire and the requirements of the instruments or to some other rules? If so, give the principal rules. A. The wiring of a circuit is determined by the current it is to carry, the drop to be allowed in it, etc. The tables of the Underwriters are the general guide for size of wire. You will find Cushing's "Wiring Handbook," price $1, by mail, a good book on the subject. The edition for 1901 is just out. 2. How many candle power can a 75 watt dynamo, capable at 1,400 revolutions of producing 15 to 20 volts, and at 2,000 revolutions 40 to 50 volts, furnish? Also, how the candle power could be divided up into seven different lamps in order to get best results? A. Two and a half to four watts are to be allowed per candle with small lamps. With 75 watts you can have 20 to 30 candle power. If you have 7 lamps on 20 volts, you will have about 3 volts for a lamp, and you will need 1 candle power lamps, 7 in a series. At 50 volts you can use 7-volt lamps, and can have 2 candle power lamps, in series. 3. Which do you think is the better for both general and accumulator use—the series or the shunt-wound dynamo? A. A series dynamo is not adapted to the work of charging storage cells. Use a shunt-wound machine. 4. Can dry batteries, when exhausted, be used for accumulators; and, if so, how many would be required for the above dynamo? A. We know of no way to use dry cells as accumulators.

(8118) J. K. asks: 1. How can I make a core for an induction coil, for medical use or igniting use? A. The core of an induction coil for any purpose consists of a bundle of iron wires, covered with paraffined paper or other insulation. Upon this the primary coil is wound. Full instructions for winding a medical coil are given in Bottone's "Electrical Instrument-Making," price 50 cents, by mail. 2. Can an incandescent light be produced without a dynamo; and, if so, how? A. Yes; a small lamp may be lighted by a primary battery. 3. How can I construct a small electric motor for running small machinery? A. Follow the directions given in the SCIENTIFIC AMERICAN SUPPLEMENT, 641, 759, or 1210, price 10 cents each.

(8119) A. McD. asks: Is there a water motor used to run a dynamo? Is it a success? A. A dynamo can be run by water power as well as by steam. It is necessary to secure steady motion by a steady pressure of the water. For water motors see our advertising columns.

(8120) B. G. J. asks: 1. To change an alternating current that now has a pressure of 50 volts to one of 115 volts, what effect would the increased pressure have on conductor and the rubber insulation, the present conductor having the capacity of 10 amperes? A. No appreciable effect. The difference between the voltages is too small to make any difference. 2. Would it be necessary to increase the size of the conductor? A. No; the conductor could be diminished if any change were to be made in it for the same current. The higher the voltage the smaller the conductor needed to carry a given amount of electricity. 3. Are transformers made to step down 5,500 volts to 115 volts? A. Yes; such transformers would be supplied by any company furnishing current at this pressure.

(8121) A. W. P. asks: 1. What is the object in having a vacuum in coherer tubes? A. It is not necessary to have a vacuum in the coherer tube for wireless telegraphy. 2. What kind of burner should be used with acetylene gas to obtain a hot blue flame for laboratory work? A. A party claims to have a jet which will produce a colorless flame with acetylene and burn safely so long as it is properly used. It is unnecessary to say that mixtures of air and acetylene are explosive, and unsafe. We are not informed how the burner in question is constructed. 3. How do the following rank as insulators: Hard rubber, paraffin wax, paraffin oil, dry shellacked wood, glass? A. We are not able to give any exact figures of relative resistance of the various insulators. Much depends upon the temperature and condition of the substance. All become fairly good conductors as soon as chemical change begins. Glass conducts as an electrolyte as soon as it softens. 4. If the terminals of a 3-inch spark coil be brought close up to opposite sides of a large cake of paraffin wax 1 inch thick, would there be any appreciable flow of current through the paraffin? A. No. 5. In experimenting with wireless telegraphy and electric wave radiation, could wooden balls, covered with tinfoil, be used in the oscillator in place of the brass spheres usually employed for such purpose? A. It was at first thought that the surface of the balls must be most highly polished for use as transmitters, but this is no longer done. Whether so rough a body as tinfoil would transmit at all or not we cannot say. You can make experiments and find out the result. 6. To what extent will zinc sulphide fluoresce under the influence of Roentgen rays, as compared with calcium tungstate? A. We are not aware that zinc sulphide has been used at all for fluorescent screens. If it is serviceable for that purpose it would drive out calcium tungstate, since it is very much cheaper.

(8122) C. J. B. asks: Is it possible to enlarge a photograph by projection? By this I mean to insert a negative in the camera, behind which there is a source of light, in place of a plate and project the image on a piece of rapid paper. I tried this several times and could get nothing more than reduced silver on the paper. A. It is possible to make an enlargement in the manner described, if properly arranged. The operation must be performed in a room entirely dark, so that no light can strike the paper except that which passes through the negative. The light must be in a box from which no light can escape into the room. A ground glass, or opal glass, or oiled paper must be put between the light and the negative to diffuse the light and prevent a flare spot from forming in the focus of the lens. If a perfectly distinct and sharp image of the negative can be seen on the paper a photographic positive can be made on the paper by giving the proper exposure. An exposure much longer than to daylight will be required, of course, since any artificial light is weaker than daylight. Bromide enlargements are made very often in this way. The best way, however, to make an enlargement is to use a camera with two bellows, with the lens in the middle between the bellows, with a holder for the negative at one end and the plate holder at the other end. The bellows are longer than they are in ordinary cameras, to give room for making enlargements of various sizes. Such cameras are sold under the name of Copying Cameras. An ingenious person can make an attachment for an ordinary camera which will answer the same purpose.

(8123) L. P. R. writes: I wish you would publish through your paper the several causes of knocking in rail joints. A. The knocking at rail joints is caused by the wheels striking a depression at the joint of the rails, made by a separation and the wear made by the wheels rolling over the joints. An additional cause may also come from loose fish-plates, which allow a slight depression of the end of the rail that the wheels are passing off, when the wheels will strike the elevated end of the next rail, and thus make a slight depression at the joint.

(8124) H. D. W. asks: 1. Can you give me any formula for an induction coil suitable for running a wireless telegraph? A. A coil is described in SUPPLEMENT 1124, price 10 cents. The coil is put to its strongest spark by adding cells of battery. Six or eight cells should be sufficient for the coil named above. 2. Is it known how Tesla gets his 100-foot spark. A. We presume by one of his oscillators. 3. Would it be any cheaper to make an apparatus like his or to make an induction coil (for 10-inch spark)? A. The coil is much cheaper. A coil giving a 10-inch spark is described in Bonney's "Induction Coils," price $1, by mail. 4. Can you tell me of any explanatory or descriptive articles on wireless telegraphy? A. See Fahie's "History of Wireless Telegraphy," price $2, by mail.

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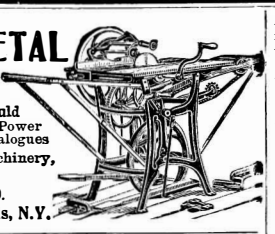

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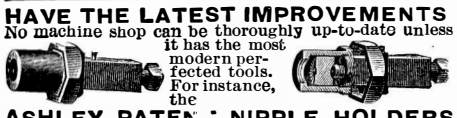

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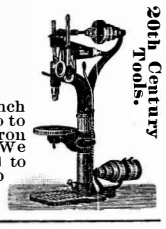

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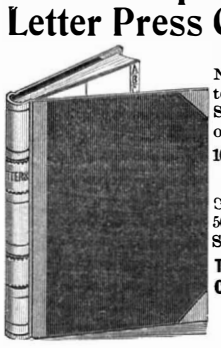

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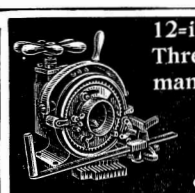

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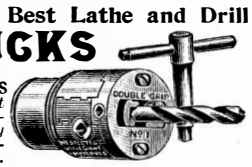

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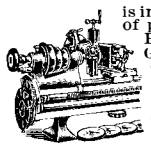

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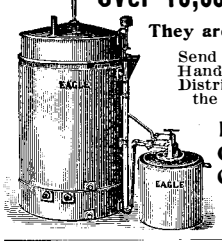

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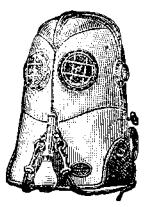

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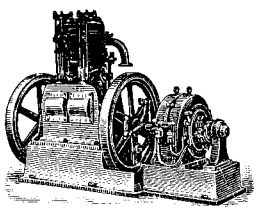

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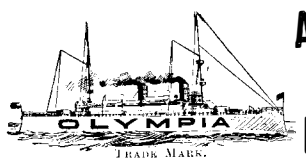

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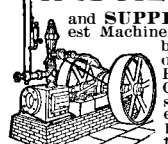

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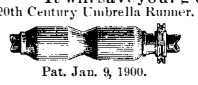

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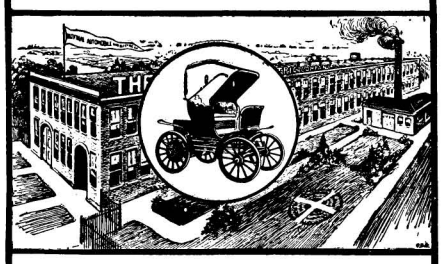

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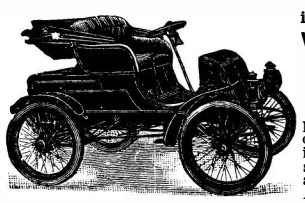

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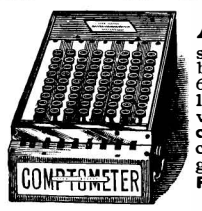

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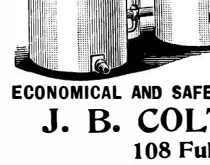

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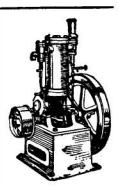

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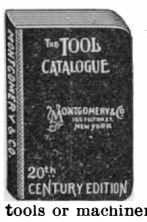

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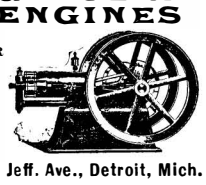

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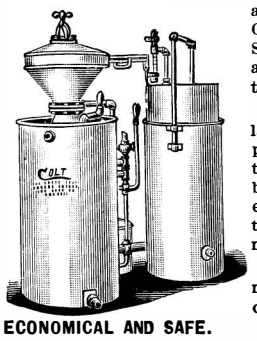

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